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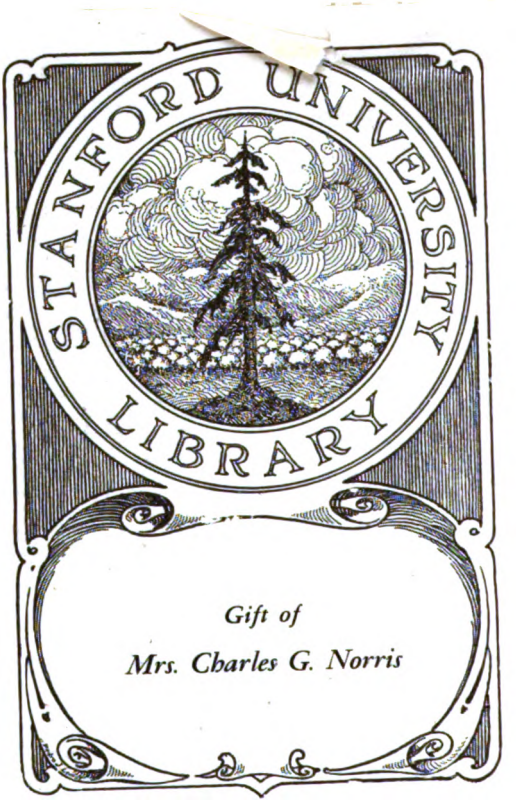

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HERTHA AYRTON

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HERTHA AYRTON
1854-1923

A MEMOIR

BY

EVELYN SHARP
Author of "Somewhere in Christendom," "The War of all the Ages," etc.

WITH ILLUSTRATIONS

LONDON
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1926
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TO

MADAME CURIE

THIS MEMOIR OF HER FRIEND

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PREFACE

It will doubtless occur to the readers of this biography, as it did to the biographer before writing it, that only a scientist could properly record the life and work of Hertha Ayrton. That would certainly be true if Hertha Ayrton had been solely a woman of science. But she was much besides; and in her passage through life she touched on so many other vital issues of her time that an account of her scientific work only, important as this was, would not be a full account of Hertha Ayrton. One of the chief interests of her career lies in the fact that she came midway between two great periods and had the intellectual qualities and the originality of mind to absorb and reflect some of the meaning of both. First, as a brilliant young girl, moving in the circles of the later Victorians—George Eliot, J. R. Green, Roden Noel, William De Morgan, William Morris—then as an early Girton student in whom the educational pioneers, Barbara Bodichon, Emily Davies, Madame Belloc, were all interested, she takes us back equally to the decline of a crinolined femininity and to the beginnings of the modern so-called woman's movement.

The next period of her life, leading up to, and including, her marriage and the years after marriage, brought her into the scientific world, where, as the acknowledged authority on the electric arc, and later, as the discoverer of startling new phenomena in wave-motion, she became

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widely known in scientific circles, was the first woman to receive exclusively in her own right one of the Royal Society's gold medals for original research, and, but for her sex and married status, would almost without doubt have written F.R.S. after her name. At this, the height of her scientific achievement, the new militant branch of the suffrage movement swept her into its onward rush; and right up to 1914, she sacrificed for the cause of women's political freedom much of the time and power that would have been given otherwise to her work in the laboratory. With the outbreak of war came the appeal to her humanitarian impulses through an inspiration to apply her discoveries in water-movement to the invention of an anti-gas fan or flapper, known as the "Ayrton fan," which saved many thousands of our soldiers at the Front from gas-poisoning. Her later researches, after the war, made with a view to the further application of this invention to the improvement of modern industrial conditions; her support of the new Labour Party; her internationalism and her many private interests and activities, filled her life right up to its close in 1923.

She was physicist, suffragist, democrat, humanitarian, and very human woman—but never any of these things in a water-tight compartment; and that must be my primary excuse for having ventured, without any scientific training, to undertake this account of her life. My other excuse is that Hertha Ayrton was my friend; and since friendship boasts of being stronger than death, there can surely be no more appropriate task for the friend who survives than to reconstruct, however imperfectly, the life story of the friend who has passed on in advance.

I wish to express my thanks to Professor Mather, F.R.S., Mr. C. E. Greenslade, Miss Haslett and others,

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for their valuable help to me when writing the scientific portions of this book; to the Mistress of Girton and Lady Stephen, as well as to the late Mistress (Miss K. Jex-Blake), Miss Sheldon, and other of Hertha Ayrton's college contemporaries, for their aid in building up a picture of her Girton days; and to Mrs. Barbara Ayrton Gould, Mrs. Edith Ayrton Zangwill, Mrs. Ayrton Chaplin, Mrs. Charles Hancock, Miss Cécile Hartog, Madame Curie and several others, for the loan of letters and for further information regarding various aspects of my task.

E. S.

LONDON,
February, 1926.

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HERTHA AYRTON: A MEMOIR

CHAPTER I

EARLY CHILDHOOD (1854–63)

Phœbe Sarah Marks, afterwards to make her name as Hertha Ayrton, was born at 6, Queen Street, Portsea, on April 28, 1854. Her parents, Alice Theresa and Levi Marks, were then living at Petworth; but it appears from the Portsmouth register that Mrs. Marks came back to her old home in Portsea for the birth of this, her third, child, returning afterwards to the beautiful old Sussex town where her husband carried on a small business as clockmaker and jeweller.

To understand the various elements that went to the making of Hertha Ayrton it is essential to know something about her family. Her father, the son of a Polish innkeeper, had fled to this country to escape the Jewish persecutions under the old Tsarist régime. His health, probably undermined by these youthful experiences, was never good; he died early, and he cannot be said to have made a success of life, as success is generally understood. He was very good-looking, and certainly skilled at his work; and his failure to grow rich probably sprang neither from want of outward attraction nor lack of natural ability. His figure remains for us a shadowy one, but it is fair to attribute to the handsome and clever, if somewhat unworldly, political refugee much of the personal charm as well

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as the gift for mechanics that were afterwards marked characteristics of his daughter.

Tradition easily gathers round a family history that is cut short at one point by flight from a country obscured in the confusion of massacre and revolt. A very pretty tradition connected with Sarah's great-grandfather on the maternal side deserves, however, to have survived, if only as a romantic adventure. The hero of it was also a Polish refugee, though in his case the motive for escape was sentimental, not political. Betrothed and married against his will at the age of thirteen to an equally irresponsible bride of eleven, he ran away to England, where in the grand traditional manner he worked his way up from errand boy to city merchant. Anxious to seal his position by a marriage of convenience with the daughter of a fellow-trader, he sent a friend over to Poland with instructions to seek out his lawful wife and make the necessary arrangements for him, in the old Jewish phrase, to "give her the gett." He was so confident that she would be similarly anxious to be rid of him that he proposed meanwhile to the other lady, was accepted, and proceeded to buy and furnish a house. On the return of the emissary from abroad, he hastened to his house and eagerly demanded the confirmation of the divorce. "Come into the next room first and see what a wonderful piece of merchandise I have brought back," answered the other, who was also a merchant. In the next room stood a beautiful young woman with whom the former refugee fell instantly and irretrievably in love. Needless to say, she proved to be his wife, who had shown no desire to accept the "gett" at his hands; and, the English fiancée having been amicably accommodated with the house and furniture, the reunited couple settled down and presumably lived happily ever after. This tale of romance persisted in

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the family till it reached the relative who passed it on to the present writer; and no one will deny that it is a pretty story. But there is no evidence to be found in the records of the struggling family at Petworth that the hero's wealth was handed down with the story.

Mrs. Levi Marks was a Miss Moss, and her father, Joseph Moss, described in the register as a glass merchant, was a well-known and respected tradesman in Portsea when his granddaughter Sarah was born over the business premises in Queen Street, now (1925) occupied by a tailoring firm. Joseph and Amelia Moss had twelve children, eight of whom were daughters; and wealth does not stay or easily accumulate in a family of these proportions. "Eight daughters?" Mrs. Moss is said to have been fond of remarking. "Yes! And I have married them all without faces and without fortunes." Mrs. Moss is reported to have been what is generally known as a "character." It is only fair to add, however, that for the sake of her witticism she considerably depreciated the appearance of her daughters, all of whom were good-looking, and one or two especially so.

Alice Theresa came about midway in this numerous family, and the story of her marriage to Levi Marks was typical of the period. She had more than one suitor, it appears, but when proposed to by the particular lover who was agreeable to her, she refused him coyly, under the impression that this was the proper maidenly way of receiving an offer of marriage the first time it was made. Unfortunately, in this case, there was no second time; for the innocent fellow failed to play his part in the little comedy and took her at her word. When, after his departure, the good-looking watchmaker came and offered himself, the mistake was not repeated. He was accepted forthwith, and the couple were married

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in the Portsmouth synagogue on November 23, 1851.

Whatever she inherited on her father's side, Mrs. Ayrton always emphasized in after-life that she owed most of all to her mother. Her mother and her mother's family played an important part both in her natural equipment and in her upbringing. The financial inability of the Mosses to give their numerous daughters a good education did not keep their natural gifts from asserting themselves, nor their father from encouraging their intellectual tastes—up to a certain point. Possibly, he even went so far as to be of the same mind as the writer of the ingenuous article that appeared some years later in the *Quarterly Review*, when the new women's college at Hitchin was under discussion, in which it was kindly conceded that, for girl students who were likely to go to such a place, a "training in housekeeping, regular needlework," and so on, might be combined with "such cultivation as will make a really good wife, sister and daughter to educated men." Some fear lest he should be encouraging them too far even in this cautious direction seems to have occurred to Mr. Moss's mind, while his daughters sat and sewed in the parlour at Queen Street and he read aloud to them, on alternate days from a novel and a serious work; for, suspecting that his listeners were beginning to spend too much time over their books, he threatened to confiscate their library. The threat was never carried out, however; and one interesting effect of it was to make the offenders, in alarmed anticipation, learn whole pages of poetry by heart, especially from their favourite poems, *Childe Harold* and *Lalla Rookh*. This absorption of literature under difficulties may have accounted further for the publication of a little book of verse dedicated to Bulwer Lytton—*Early Efforts*, by the Misses Celia and Marion Moss—a copy of which used to be

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exhibited among Queen Victoria's books in Kensington Palace. Marion Moss afterwards married Mr. Alphonse Hartog and kept, with her sister, Mrs. Leo, the London school in which Phœbe Sarah Marks received her early education.

Sarah's mother never pretended to be one of the intellectuals among the sisters who listened to their father's daily reading. She probably sewed the better for that, and her talent for exquisite needlework was transmitted in full to her daughter. Alice Moss's brains were of the more practical and constructive kind, and fortunately so, for she needed all her force of character to contend with the difficult circumstances of her married life and the long widowhood that succeeded it. She was certainly a remarkable woman, considerably in advance of her times both in her general outlook and in her views about women, and one can understand in how hard a school she acquired her knowledge of life as well as her broad humanity. She had a husband who, however lovable, evidently lacked the elementary capacity to earn his living. On his meagre earnings she had to keep the home together for the seven children who were born before his death. That would seem to most people a sufficient task in itself. But it was not sufficient for Mrs. Marks, who, wherever she was, made herself a centre of public work and usefulness. "Our Alice" was the name by which she was known in Portsea; and, according to an inhabitant of the town who knew her in his early boyhood, "she was always at everybody's beck and call, and was never known to refuse an appeal for help, wherever it came from." This informant added that it was sometimes suggested that her six sons might have turned out better if she had occupied herself less with public affairs. "But," he added, "I don't think so myself; a widow left with insufficient

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means cannot be expected in any case to bring up sons satisfactorily without a father's help."

Perhaps it will not be out of place, seeing the very great influence that Mrs. Marks's character had upon that of her daughter, to anticipate here what was said of her in the sermon preached at her funeral, many years later:

"Endowed with determination, perseverance and wisdom, she quitted this life full of honours and veneration. She was a model wife and loving mother. Thousands would have sunk under the burden cast upon her, and would have leaned for support on the charity of their friends; but although left a widow with a large family without any means, she courageously struggled on to maintain her family, to educate them and make them good members of society. In this she succeeded; but she achieved more, for philanthropy and charity were her great points. Religion and race knew no distinction with her, and she found time to perform all those kindnesses which would hand down her memory to posterity."

Those who knew her daughter afterwards will readily believe that such qualities belonged to the mother; they will understand, too, why the Hertha Ayrton of later days never failed to attribute her own achievement largely to those qualities and to the high standard set before her by her mother, from her earliest childhood.

But from a material point of view it cannot have been an easy childhood. When the watchmaker transferred his business and his family from Petworth to a small house in Butcher Street, Portsea, Sarah was about four-and-a-half years old, and two more children, both boys, had been added to their number. By the time the family had been increased to seven, Sarah still remaining the only girl, she had become quite a responsible person in the home. Already she was performing tasks far beyond her years; at the age of six, when her youngest brother was short-coated, she made every

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one of his little garments; and by her invaluable help in looking after the children she set her mother free to add to their slender income by needlework. Long afterwards, Mrs. Ayrton would tell how, when little more than a baby herself, she used to cut out cardboard dolls and dress them in bits of paper and odd snippets from her mother's work-basket, to take the place of the toys that would have fallen to the lot of wealthier children.

Her own recollections of those early years of struggle were, however, anything but gloomy. A relative of her husband's well remembers the scorn with which Mrs. Ayrton once greeted the remarks of some well-meaning philanthropist, who deplored the evils consequent upon allowing children to play in the streets. "You know, I always played in the streets at home," she said frankly; "and it never did me the slightest harm." Mrs. Marks's enlightened manner of upbringing must have had much to do with the careless happiness of those early days. Sarah was never beaten at home, or indeed, disciplined otherwise than by kindness and the appeal to reason. An incident, therefore, that stood out in her memory was one that occurred when she was about five and was attending a little dame school in the neighbourhood. Here, on one occasion, she was called upon to confess some childish offence of which she had been wrongfully accused, and indignantly refused to do so. Even under the threat of corporal punishment she still persisted in her refusal, and, when finally caned on the hands, ran straight off home, storming at the outrage and the injustice. Her mother wisely removed her at once from the school and probably saved her from brooding over an evil memory with harmful consequences. But I think the incident made its impression, all the same; for throughout her life, any

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suggestion of harshness or tyranny towards children would rouse her to instant protest. At Girton, in 1878, although utterly inexperienced in public speaking and not at all given to intervening in the college debates, she spoke hotly in favour of the motion: "That Mill's doctrine, that fear is a necessary element in the education of children, is erroneous;" and, about that time, she wrote to Madame Bodichon in derision of some old-fashioned treatise on education she had been reading, adding at the end of her impetuous criticism: "Reading this makes me long more than ever to have some children and bring them up properly."

Another incident occurred during this early period at Portsea of which Mrs. Ayrton often spoke in later life, and which was as typical of her mother's local reputation as it was prophetic of her own subsequent development. A neighbour, who happened to be particularly small in stature, had been attacked by a drunken negro of such massive proportions that nobody in the crowd, which immediately assembled, had the courage to separate the two men. The victim was actually being strangled and had already turned black in the face when, as though it were the common procedure to follow in a crisis, somebody ran to fetch Mrs. Marks. Being herself extremely short and slight, she could not hope to prevail against the negro by muscular effort; but without stopping to consider risks, she went straight up to him and bit him sharply in the hand; he relinquished his hold with a yell, and Mr. Emanuel's life was saved. Mrs. Ayrton's daughter still possesses a silver salver inscribed as having been "Presented by H. M. Emanuel and Family to Mrs. Alice Theresa Marks, as a token of remembrance and gratitude." The incident tempts one to anticipate again and to compare Mrs. Marks's promptitude on this occasion with her

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daughter's action, many years later, when Mrs. Ayrton rushed without hesitation under the legs of a horse and rescued a little boy from being crushed by the wheels of the carriage. Some one, remonstrating with her for running this risk, was rebuked by the surprised tone in which she replied: "But if I hadn't, the child would have been killed, or perhaps crippled for life!"

It was fortunate for her children that Mrs. Marks was a woman of capacity, for she soon became wholly responsible for the family income. Her granddaughter, Mrs. Ayrton Gould, has preserved the "licence for a hawker trading on foot," granted to Levi Marks on January 10, 1860, which shows that the little Butcher Street business was not doing well and an effort had to be made to stave off impending ruin by hawking the stock of clocks and watches about the countryside. But the attempt does not appear to have been very successful; for when the father died in his sleep, early on a summer morning in 1861, the only inheritance he left behind him was one of many debts, and his only assets were the courage and resourcefulness of his wife and the yet unknown potentialities of his daughter. "Mother says you are to light up for poor father—peace to his soul—on Tuesday night, and burn till Wednesday morning," writes one of the younger children to Sarah in London, fourteen years later; and this injunction to perform the Jewish rite of the "Jahrzeit" in his memory seems to indicate that he was not forgotten, or his want of worldly success ever recorded against him.

Lavinia, or Winnie as she was always called, was born, a delicate infant, seven months after Levi Marks's death. The elder sister at once assumed a responsibility for her that was never shirked or laid down until, after thirty years of ill-health and dependency, Winnie died in October, 1891. The love of children that was

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so striking a trait of Mrs. Ayrton's character all through life found its earliest expression in the affection she lavished on the little sister, in defiance of all her failings and shortcomings; for naturally, Winnie developed many of the failings that are common to invalids who have been indulged from their birth. But she was always sincerely attached to the sister who was so good to her, and conscious of the sacrifices she made for her.

After the father's death, Mrs. Marks moved with her young family into the house at 11, Union Street, Portsea, which remained her home until she went to live in London in 1890, after her daughter's marriage to Professor Ayrton. It was a larger house than the one in Butcher Street, and it is possible that the change was necessitated by the addition to the household of old Mrs. Moss, who, after the grandfather's death and the winding up of the glass and china business in Queen Street, came to live with her daughter Alice. When Sarah was nine years old, an offer was made to her mother by Aunt Marion, then married to Mr. Alphonse Hartog, to take the child into their school in London and educate her with her cousins. To part with her must have been a serious sacrifice to Mrs. Marks, and not only for reasons of sentiment. The widow was now wholly supporting the family with her needle, and the clever little daughter, who so ably relieved her of the work of supervising the other children, might almost excusably, under such difficult circumstances, have been allowed to degenerate into the family drudge that in those days was considered the proper position of a daughter born into a family of sons. Fortunately, overburdened as she was, Mrs. Marks was alive to Sarah's unusual ability and sensible of the advantages likely to accrue from the acceptance of Mrs. Hartog's generous offer. Sarah's mother had always held the view that women needed a

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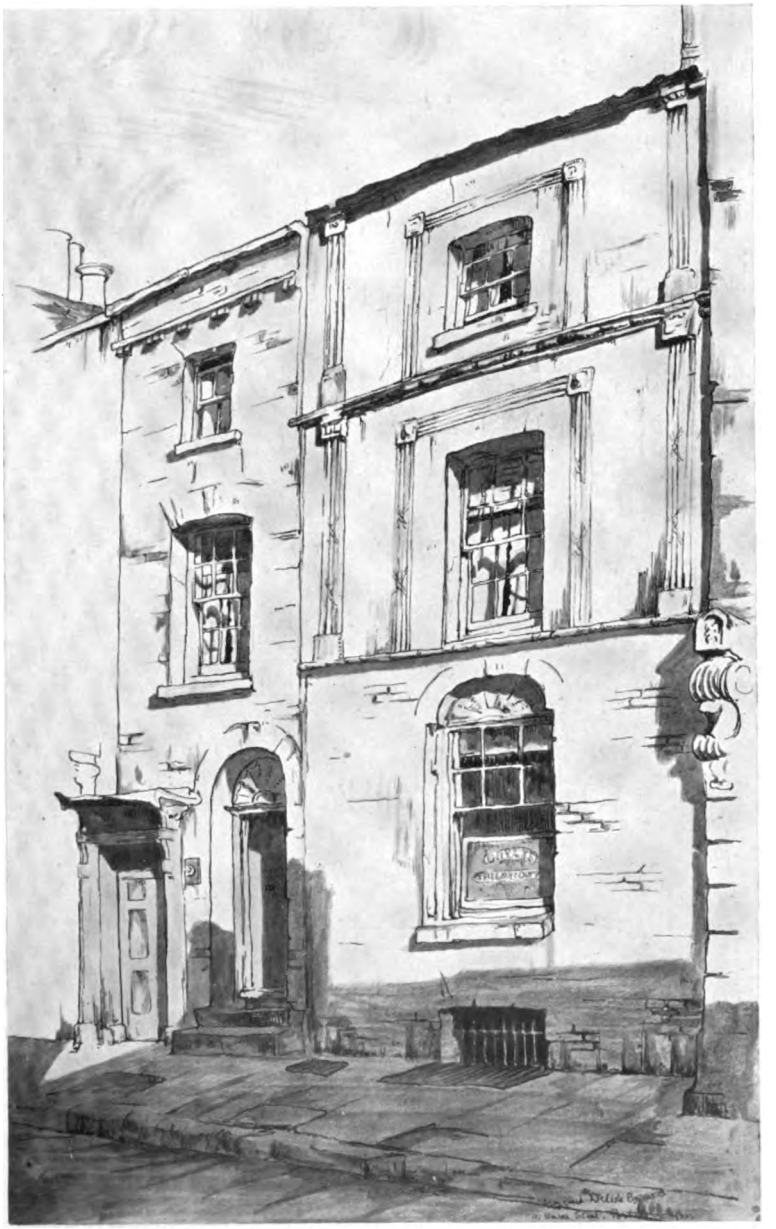

HERTHA MARKS' HOME AT PORTSEA

From a drawing by Margaret Delisle Burns

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better, not a worse education than men, because, as she generally added, "women have the harder battle to fight in the world;" and although her uncompromising feminism may have been driven into her by circumstance, it had fortunate results for Sarah. The sacrifice was willingly made, and the first chapter in her daughter's life was closed when she went up to London in the 'sixties to become a member of her Aunt Marion's household at 300, Camden Road, N.W.

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CHAPTER II

SCHOOL DAYS (1863–70)

At nine years old, Sarah Marks was very much of an individual. The clear grey-green eyes, whose extraordinary brilliance, described by one friend of her childhood as almost mystical in quality, was maintained up to the time of her death, were already a striking feature in her appearance; so was the thick mass of raven-black hair which hung down in regular curls, fashioned stiffly round a stick after the manner of the period. Even at this early age she impressed strangers with her strong personality; and it is conceivable that there were moments in her school career when a little less unconventionality in her general equipment would have made it easier for her to fit into her surroundings. A certain crudeness, of course, was only to be expected. Until then, she had known no restraint except what was imposed by circumstance; and children, not unlike their elders, rarely resent the tyranny of circumstance as they are quick to resent the tyranny of those who are set over them. The little cousin from Portsea had, too, a practical experience of life that was naturally lacking in her schoolfellows, who had certainly never played in the streets, or been placed in the home on an equal footing with their parents. Yet, for all her precocity in some directions, Sarah had remained astonishingly simple in others. She knew nothing of what commonly passes for discipline. Except

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for the one incident which secured her removal from the dame school, she had never encountered arbitrary authority, her relations with her mother being of a different character altogether. Her upbringing, in fact, had been admirable for setting free in her that natural refinement of mind and originality of thought that were to make her in the fulness of time independent of early drawbacks and deficiencies; but it was not an upbringing that helped to make her at the age of nine a docile little schoolgirl. Knowing much that others had not needed to learn, and ignorant of a good deal that they knew and thought essential, she must have seemed to her more sophisticated relatives something of a barbarian; and the torture of home-sickness, inevitable in a child as tenderly cherished as she had been, helped to accentuate a period of unhappiness that always remained a vivid and painful reminiscence of childhood.

No doubt, in these days of child psychology, she would have been better understood and perhaps enabled to evade some of the misery attendant on a first absence from home. At the same time, the Hartogs were more likely than many people of that period would have been to recognize an unusual personality. Aunt Marion and her family were not ordinary people themselves; and the education they were able to give Sarah was a good deal better than would have been available in the average private school of the 'sixties, if one may judge of these from the illuminating Report of the Schools Inquiry Commission that appeared in 1864. From her Uncle Alphonse she obtained a knowledge of the French language that was to prove of great value to her afterwards, both in her relations with the Bodichons and in her later scientific connection with Paris and the Curies. To her Aunt Belle (Mrs. Leo) she owed the beginnings of a good musical education; and from her

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eldest cousin Numa, when he was down from Cambridge, she first learned mathematics and Latin.

All her cousins had distinction of mind in one way or another. Numa Hartog was the first Jewish senior wrangler and a brilliant mathematician, whose untimely death from small-pox, when Sarah was about seventeen, cut short a career that promised to be remarkable. Of his two brothers, Marcus, the elder, became Professor of Natural History (afterwards, when the Chair was divided, of Zoology) at University College, Cork, and died in Paris in 1924, two years after his retirement; while the younger, Dr. Philip Hartog, is at the moment of writing (1925) Vice-Chancellor of Dacca University. There were two daughters, the elder of whom, Madame Helena Darmesteter the painter, has lived in Paris since 1877, the year of her marriage to Professor Arsène Darmesteter; in addition to being an Associée de la Société Nationale des Beaux Arts, she has further been decorated with the *palmes académiques*. The younger daughter, Cécile, afterwards to become the pianist and composer, was not much more than a baby when her cousin came to school; and Sarah's instant devotion to her, as to all children who ever crossed her path, marked the beginning of a long friendship between the two cousins.

Mrs. Hartog was naturally the outstanding personality of the school. The claims it made upon her, in addition to those of her own family, had caused the abandonment of her early literary ambitions in favour of the pursuit of educational ideals; and the *Jewish Chronicle* (August 23, 1895) speaks of the many pupils who had "been brought in contact with her strongly marked individuality and great educational powers." But these qualities, excellent in themselves, did not necessarily appeal at once to the little niece, who was herself an

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exceptional child with a strongly marked personality of her own. There can be no doubt that the sudden change from the happy freedom of a home where no check was placed upon her development, to the restraint of school, meant for Sarah a transitional period of acute suffering that she never forgot. The position seems to be fairly summed up in a remark made to the present writer by a relative of Professor Ayrton's, who was also one of Mrs. Ayrton's closest personal friends. During a discussion of her early school days, this informant said: "Mrs. Hartog was undoubtedly able to give Hertha something that was lacking in her own home; at the same time, it must not be forgotten that she could not have helped her in this way if Hertha had not been one of those rare people who are independent of their environment because they are refined by instinct and have an inborn elevation of nature and an unerring preference for the highest and best."

There were plenty of reasons, besides her sensitive nature, why the course of Sarah's training should not have run smooth, and why, as she used to relate afterwards, she often locked herself into the bathroom to weep in secret for the mother who had judged by a different standard some of the failings for which she was censured at school. The child's disregard for her personal appearance continually got her into trouble. So many were the reproofs that were, literally, called down upon her head by the rebellious nature of her long hair that she induced her mother, in her first holidays at Portsea, to cut it short, and returned to school with a shorn crop of uncontrollable curls that defeated her object by causing her less than ever to resemble a demure little mid-Victorian schoolgirl. But there was one occasion on which, though dearly won, the victory was hers. As in the dame school at Portsea, she was

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inadvertently accused of some fault she had not committed and therefore refused to admit. Her failure to convince the authorities that she spoke the truth—they had not yet discovered how impossible the contrary would have been in her case—was unendurable to one of her proud nature; and out of her desperate sense of impotence she conceived the idea of a hunger strike, which is interesting as showing how this form of protest may originate entirely in the unprompted impulse of the rebel driven to extremities. For two-and-a-half days she came to every meal but steadily refused to touch food, until, both alarmed and convinced against their will of her innocence, her harassed elders had to give in and concede her point. The incident was typical of a character that developed in many ways as the years went on, but never wavered in a passionate devotion to truth and justice. It has another significance, too, in view of the little hunger-striker's much later association with a political movement that adopted the protest of the hunger strike in prison.

There came a time, however, when early crudities began to wear off and a better understanding prevailed between teacher and pupil. Directly an opportunity occurred for the assertion of real values, Aunt Marion showed that she was perfectly aware of her niece's strong points. Two of the younger children, Cécile Hartog and her cousin Rosa Leo, went down with chicken-pox during term time; and Sarah, who was then eleven years old and had already had the childish complaint, was appointed to share their isolation and look after them. It was a responsibility after her own heart, as Aunt Marion wisely realized; for here at all events was a task for which Sarah's childhood, full of similar responsibilities, had admirably fitted her. She did in fact perform it so well that the doctor was loud in his

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commendations; and Aunt Marion rewarded her with the present of a white sailor hat trimmed with long blue ribbons, which, as she once told me, seemed to her "the loveliest thing I had ever seen!"

Miss Cécile Hartog remembers her admiration for this elder cousin of hers, who was so clever with her fingers that she could make perfect miniature dolls' note-paper, gummed envelopes and all, and once made a frock for a doll four inches high and insisted on facing its tiny pocket with silk. She recalls, too, that Sarah at the age of twelve took a watch to pieces and put it together again, manifesting a talent that was evidently inherited and untaught. Another and a different trait was her physical courage and daring. She was constantly climbing trees or performing some tomboyish feat of the kind; and once, a dare-devil impulse caused her to make the tour of a room without touching the floor, although it involved climbing over a high cupboard. This particular sort of prowess stood her in good stead when, years later, she helped to form the Girton fire brigade and was instrumental in overcoming Captain Shaw's prejudices by showing him that a woman could climb ladders as well as a man.

She was much given to enthusiasms, not always of a lasting nature, though she would listen to no arguments against the craze of the moment until the next one took its place. Once, she determined to become an artist, and under the domination of this passion greatly resented Aunt Marion's refusal to allow her to go out sketching at four o'clock in the morning. Her drawing, like everything else she did with her fingers, was scrupulously accurate, and she would reproduce the leaves of a tree with meticulous care. Although she soon relinquished the idea of taking up painting as a profession, she did not lose her love of sketching,

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which, at a later period of her life, became one of her favourite recreations; and she left behind in her daughter's possession many charming water-colour sketches.

Another craze, for acting, found an amusing outlet on one occasion, when Sarah collaborated with two others in writing a school play in which she took the part of the hero, dressed in a borrowed suit and top-hat. Unfortunately, very little record remains of this early effort, except an unforgettable picture in the family mind of Sarah, posed picturesquely on her knees in this mannish costume, saying in ardent tones to the heroine: "Isabel! May I, dare I hope? Say Yes, and raise my hopes for ever—or No, and crush them!" It was on this dramatic occasion that she first sang to an audience slightly larger than the usual one composed of members of the household; the hero's part included a sentimental song, composed by the musician uncle, Mr. Louis Leo, of which the first two lines ran as follows:

> Look out upon the stars, my love,
> And shame them with thine eyes.

Whatever she did, then or afterwards, was characterized by the same intense absorption. "If she paints shelves," was said of her by a friend who caught her at this occupation many years later, when painting shelves seemed a little incompatible with a serious scientific career, "she paints them as if nothing in the world mattered except painting shelves!" In the same spirit, she once threw herself with enthusiasm into the engraving of a new ground-glass window for her drawing-room in Norfolk Square, which had been broken, and which, although the task demanded exceptional cleverness on the part of an amateur, could have been far more appropriately replaced by the builder. While she was

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doing this she was ordered a day's rest from her scientific work, the only result of which appeared in a letter she wrote to her daughter (September, 1911), in which she said exultantly: "I have done a good day's work on the window, and it will certainly be finished on Sunday!" as though she were announcing the completion of a critical scientific experiment.

During her school days, she showed many signs of qualities that eventually formed part of her character. The friends of her childhood unite in emphasizing her kindness and generosity and her big way of looking at things; there was never anything small or mean about her, and if this peculiar grandeur of nature sometimes rendered her incapable of understanding the failings of others, and even made her appear intolerant on occasion, this particular defect was only a defect of her qualities. Similarly, her tremendous interest in things, her fresh way of approaching new facts, sometimes made her a little impatient of correction, a little too certain that opponents must of necessity be wrong. No large family, of course, could be expected to allow self-assurance of this kind to pass unchallenged; and when, rather later than her school days, at a period when she had already become an agnostic in religious matters, she argued hotly that the word "Midi" could not possibly be applied to the South of France because it meant "middle," the family retorted, as families will, in doggerel:

> Sarah, with voice so clear and low,
> So sure of all she doesn't know,
> Who thinks that Midi must be middle,
> To whom Eternity's no riddle.

While the school years passed in a succession of minor events, the sum of which, neither wholly happy nor wholly the reverse, played its due part in the building

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of character, the economics of the household at Portsea did not improve. As the sons reached, one by one, the wage-earning age, none of them proved particularly capable of contributing to the upkeep of the home, while the delicacy of the youngest child, Winnie, was a constant source of expenditure. Sarah's occasional visits to the house in Union Street, during the seven years she lived with the Hartogs, must have revealed painfully to her the continual struggle carried on by her mother in order to make both ends meet. The increasing poverty of her family soon convinced the daughter in London, always conscientious to a fault where her own people were concerned, that she must at the earliest opportunity do something to help them. She may have argued, as time went on and she found she could make herself useful in her Aunt's school, that a way was thus indicated by which she could achieve her purpose; and teaching was, truly enough, the only way of earning a living then open to a girl in her circumstances, who had been born a little too early in the nineteenth century to consider the possibility of another career, even had the training for one been within her grasp. She therefore set about looking for a post as resident governess; and, when barely sixteen years of age, obtained one in the house of Mr. and Mrs. Gabriel, in Harley Street. The day she left the school which had seen her grow from a wild little tomboy into an attractive young girl full of interest in life, she entered upon a new set of responsibilities, and took up the task of contributing to the support of her mother and sister that she never laid down during their lifetime.

She never spoke much of her first, and only, resident engagement. She used to say afterwards that she made up her mind to stay in it long enough to secure a satisfactory reference; and the inference is that she

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was not very happy there. The chances of happiness were certainly not great. A resident post in a private family is always an invidious position for the holder of it, and perhaps for employers as well as employed; and to a girl of sixteen, full of ideas and longing to be free to carry them out, the restraint of it must have been almost intolerable. Her pupils do not seem to have discovered this; and indeed, with her love of children and her gift for teaching, she was not likely to let them find it out. I am indebted to Mr. William Gabriel, the eldest of the three sons whom she taught in this family, for some notes he kindly sent me with reference to the Miss Marks of those days:

"for whom," he writes, "I had a great regard. I remember that she was particularly fond of painting; and as an instance of her regard for absolute accuracy I may mention how, when she was once painting a fuchsia plant and one of the flowers fell off, she at once painted out the entire picture, which she said was no longer true to nature."

The same correspondent goes on to relate how she came to leave his parents' house:

"Though all this happened a great many years ago, I can recollect that when we were staying for the summer at Finchley, Streatham Common or Bexley, I forget which, she asked permission to go up to town to make inquiries at the house where her cousin, the late Numa Hartog, lay dangerously ill with small-pox, from which he ultimately died. As my parents knew her to be much attached to him, this was given on condition that she did not enter the house. I can even now well recall the to-do there was on her return, when she admitted that she had gone in to see the members of the family. I do not think, however, that she had gone as far as seeing the patient. I think that this action on her part was seriously resented by my parents and that she left us shortly after this."

Mr. Gabriel adds that, meeting her again after she was married to Professor Ayrton, he was surprised to

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find that she was short, his childish recollection having been that she was tall. It is evident, therefore, that her extreme youth, which may have led her into indiscretions where her feelings were involved, did not impress itself on her pupils to the extent of causing them to regard her as negligible.

The death of Numa Hartog, immediately after his triumph at Cambridge, was naturally a terrible shock to his family; and their cousin, who by this time shared their griefs and their joys as a matter of course, suffered with them. She did not, however, seriously regret that her own relation to the tragic occurrence brought about her departure from the Gabriels' house, for she had stayed long enough to secure her reference, and she was obviously not in her element as a resident governess. She showed considerable courage and took some risk in starting out, as she now did, to earn her living by taking daily pupils. But, uncertificated though she was, she justified her own enterprise. From this time onward, until she went to Girton six years later, she went out daily to her work (living first for a short time again with her Aunt, and afterwards in lodgings); and managed not only to keep herself, but also to send money home to Mrs. Marks. The new plan enabled her to some extent to choose her own subjects, so that she could avoid English, in which she was weak, and concentrate on mathematics. This being an unusual subject in the repertory of an uncertificated governess, she found it easier than it might otherwise have been to obtain coaching work; and there seems to have been no dearth of pupils during those years, which, although very full of work, never free of anxiety about her family, and often marked by ill-health through overstrain, were yet in many ways very fruitful years. She had interesting pupils, including one of the Cobdens, some members

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of the family of the present Lord Reading, Miss Frances Roden Noel, and others whose names recall the later Victorian age; and the foundations of lasting friendships were laid that brought her into contact with more than one new social circle, and exercised an important influence upon her future career.

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CHAPTER III

BEGINNINGS OF INDEPENDENCE (1870–75)

The friend who had the strongest influence upon Sarah Marks at the beginning of her independent career was undoubtedly her cousin, Marcus Hartog. Her senior by some years, he had just come down from Cambridge full of the new rationalism; and he brought her into touch with a whole set of young free-thinking graduates who came down about the same time. But it would not be true to say that he was primarily responsible for unsettling her faith. The strict and narrow Judaism in which she had been brought up, reacting upon a mind that insisted upon freedom of thought, had begun to antagonize her before he gave her any vision of a wider intellectual outlook. She was quite young when she wrote in an autograph album as her favourite quotation: "Prove all things; hold fast that which is good"; and this may be said to have been her guiding principle through life. Already, therefore, she was submitting to the searchlight of her own reason the beliefs that had been passed on to her in her childhood, and it is certain that the process caused her acute suffering. Until then she had been devoutly religious, and added to her mental perplexity and unhappiness there was the dread of giving pain to her mother, whose Hebrew faith remained firm and unassailable. Sarah's honesty and sincerity of thought made scepticism inevitable; and when she embarked

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on the sea of doubt, at an earlier age than most young thinkers, her cousin was at hand to answer the questions she was burning to put to some one. He helped her to steer her way, but could not do more than that for her; and long afterwards, when some one suggested in her presence that it was better for a child to be brought up conventionally where religion was concerned, Mrs. Ayrton warmly dissented and gave her own experience as an illustration of the suffering that could be involved in rejection of the faith in which one had been reared.

It should be noted that neither then nor later did she ever call herself a rationalist, still less an atheist. I have heard her say several times that she was a free-thinker, and once she described herself as an agnostic, adding quietly to somebody who had assumed that she regarded all religious beliefs as untenable: "I do not say these things are not true, only that they have not been scientifically proved." Two things may be added, on this point. First, she never made the least attempt to impose her theological views on other people, and, because of this breadth of mind, was always able to choose her friends independently of their religious opinions. At Girton, her two closest companions were, respectively, a devout Presbyterian and an Anglican clergyman's daughter; while a third, who came up to Cambridge at the age of seventeen, Miss Marks being then twenty-three, has told me that when she wished to discuss with her some theological question, the older student at once replied that she never liked to influence the religious thought of anyone younger than herself.

The second point worth noticing is that she did not renounce her Judaism when its religious observances ceased to have any meaning for her. She never lost an

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opportunity of expressing pride in her Jewish descent; and it may have been an instinctive desire to testify openly to this pride of race, as well as her devotion to her mother, that made her continue to go home, year after year, to help in the observance of Passover and to take part in its lengthy ritual.

At the age of sixteen she had consequently arrived at a mental stage when she would be naturally susceptible to the charm of the young Cambridge graduate, who came home to find that his little cousin was no longer a child. She was indeed becoming very attractive, though with her brilliant colour, her halo of black curls and her strangely penetrating eyes, she was also unusual-looking, always coming into a room, it was said of her, "like a breath of youth and life," and appealing rather to men who had original minds themselves than to the ordinary type of young man who preferred a pink-and-white prettiness. Her good looks, as well as the vitality of her mind, probably accounted for some of the zeal with which Marcus Hartog undertook her spiritual education, and certainly led to the establishment between them of something warmer than a cousinly relationship. This was Sarah's first experience of a young man's admiration, and it was easy to mistake the pleasant sensation for a love affair. What followed could scarcely be called an engagement, for its duration was absurdly short; and Sarah's eyes were opened to the true state of her emotions by her cousin's own action in taking her, one Sunday evening, to Mr. Karl Blind's house in Winchester Road, Hampstead.

There was everything in the Blind household to make her feel that she was entering a new and delightful world. Karl Blind himself, a political refugee from Prussianism, was a figure calculated to fire the imagin-

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ation of one whose father had similarly fled from a political tyranny. There was also the elder daughter, Mathilde Blind, one of the biographers of George Eliot; —and above all, there was Ottilie, the very beautiful younger daughter, brimming over, as Sarah was, with youth and eagerness and the desire to know all about everything in heaven and earth. It was her spontaneous and romantic admiration for Ottilie that settled in Sarah's mind the question of her feeling for Marcus; for, finding to her surprise that she was just as much interested in her new girl friend as she had been in him, and considerably more at ease in her company, Sarah faced the matter squarely and deduced the logical conclusion that she was not and never had been in love with Marcus. Fortunately, he arrived almost simultaneously at the same decision, so no hearts were broken over the transition of their sentimental companionship into one of intellectual affinity; and nobody was more pleased than Sarah when, not very long after, Marcus became engaged and married.

This little affair was a mere interlude, and its most important outcome for Sarah was her introduction to the Blinds and the foundation of her lifelong friendship with Ottilie. She began now to make her own circle of acquaintance and to build her own future; and as if to baptize her into a new existence, the name Hertha was given to her. She seems to have conveyed at once that impression of being unlike other people which leads friends to invent new titles for one another; and the name Hertha was evidently considered peculiarly appropriate, for it was adopted readily by nearly all Sarah's friends and even by some of her relatives. She soon came to sign herself by it, and she was known publicly as Hertha to the end of her days, most people believing it to be her real name. Ottilie Blind was

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really responsible for the innovation, which was inspired partly by admiration for Swinburne's poem, then being much talked about, and partly by a fancy of Ottilie's that in some way or another Sarah Marks resembled the goddess Erda.

There being no scarcity of pupils, Miss Marks's economic position would have given her little anxiety if she had not felt it her duty to send home a large proportion of her earnings. In order to do this she worked unceasingly and denied herself all personal luxuries, making her own clothes in addition to other economies. This was a task she might have set herself in any case, for she never wore the conventional dress of the period and much preferred to design and execute the simple frocks that suited her slight figure so much better. In spite of hard work and poverty, some of the happiest hours of her girlhood were spent in Ottilie Blind's room at Winchester Road, where the two friends met on most evenings of the week, after teaching hours were over, where they had high tea together and then studied until ten o'clock. Both were preparing for the Cambridge University Examination for Women (later merged into the Higher Local Examinations), which Hertha passed in 1874, taking honours in English and mathematics. In those days there were few, if any, evening lectures or classes open to women; so they had to coach one another, and in addition had some special lessons from Miss Lord (afterwards a Girton student for two terms in 1876); and for some months Hertha lived in the Lords' house at 1, Norland Place, W.

Even in these early days, she showed her tendency to rush on too fast in her mathematical studies, trying to apply what she knew before she had thoroughly mastered the groundwork, a characteristic that always handicapped her in examination work. She once passed

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on to Ottilie Blind a criticism to this effect from Miss Eliza Orme, a clever law student and a keen feminist, who often helped Hertha in her work and was a friend to her in many ways. Miss Blind wrote back, adjuring Hertha not to attribute this defect too readily to insufficient education; but her friend's depression about herself seems to have recurred, for Miss Blind writes again in 1873—somewhat prophetically this time—to say:

"Do not let this greyness of which you speak take hold of you; it will paralyse all your efforts. . . . Do not show me I have made a terrible mistake in thinking you possess the power to overcome your difficulties, and the mind which will some day place you among the 'salt of women.'"

Miss Orme was indirectly the originator of a string of events that led to great changes in Hertha's life, and indeed shaped her whole future career. She was instrumental in introducing her to Miss Keary, who lived in Campden Hill Gardens, and it was in calling upon Miss Keary one day, early in 1873, that Miss Marks met Miss De Morgan, sister to the novelist and a friend of Madame Bodichon's. This, as it turned out, was a fateful meeting. In the course of conversation, Miss De Morgan talked of the rapid progress of the new women's college, which had been opened at Hitchin in 1869 and, after being incorporated in 1872 under the title of Girton College, was now being established in its permanent home near Cambridge. Hertha Marks, listening eagerly, let fall her own ardent longing to go to college, which seemed at the time an unattainable ambition. The following letter from Miss Keary, dated July 17, 1873, must therefore have been received by her with surprise and delight:

"My dear Hertha (if I may call you so),—Miss De Morgan, whom you met at our house, has this moment called to say that

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Madame Bodichon has been telling her there are some new scholarships just given to Girton College, and that pupils are actually wanted there. Miss De M. remembers your having said that you would like to go to Girton, and that we had told her you were a great genius—so putting these two things together she ran in this morning to tell me to advise you to write at once to Miss Emily Davies, 14, Cunningham Place, W., . . . asking for particulars for yourself. How pleased I should be, dear, if you were to go, and come out senior wrangler! Madame Bodichon said you might use her name to Miss Emily Davies. . . . Yours affectionately, K. KEARY."

The suggestion was evidently acted upon at once, for a letter to Hertha from Miss Emily Davies, dated July 21, gave her the necessary information and proposed an interview, which accordingly followed; and although Miss Davies does not seem to have been unduly encouraging in her attitude when the meeting took place, it bore fruit only a few days later, when Madame Bodichon wrote to her as follows:

"DEAR MISS MARKS,—I should be very glad if you could call on me any time on Wednesday the 29th, after 7 p.m., at 5, Blandford Square, N.W. I am going up for Girton College business, and should like to have some conversation with you about your wish to go there. Yours truly, B. L. S. BODICHON."

This brief note, cherished among Mrs. Ayrton's most intimate papers and labelled "Madame's first letter" —Madame Bodichon was very generally called "Madame" by friends and acquaintances alike—marked an epoch in the life of Hertha Marks.

Barbara Leigh-Smith, who was born in 1827 and married Dr. Eugène Bodichon in 1856, was a very remarkable woman. She was a cousin of Florence Nightingale's, and was a prominent figure in the movement for women's emancipation, as well as a distinguished painter who studied under Corot and exhibited in the principal picture galleries of the time. George Eliot's letters

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reveal the intense interest Miss Leigh-Smith took in every branch of women's progress, but especially in their higher education. She was an early student of Bedford College, and before her marriage, and long before she became one of the founders of Girton, she originated with Miss Elizabeth Whitehead (afterwards Mrs. F. Malleson) an advanced type of school in London, which they ran for ten years and in which boys and girls of different races and different creeds were taught on new lines. The teaching was non-sectarian and included a good deal of music, while there was no corporal punishment and very little punishment of any kind. Madame Bodichon also wrote a pamphlet on *Women and Work*, and started the *Englishwoman's Review* with her friend Miss Parkes (afterwards Madame Belloc). Madame Bodichon was a woman of means, and had a big generous nature that was never appealed to in vain for any woman's cause that carried conviction. She had, too, considerable perception, and was the first to guess the authorship of *Adam Bede*, a revelation which, when made to other intimate friends by the novelist herself, created a sensation among them that caused George Eliot to write somewhat bitterly: "This experience has enlightened me a good deal as to the ignorance in which we all live of each other." It was an ignorance that Madame Bodichon—the "dear Barbara" of George Eliot's letters—did not share; and we may suppose that this devoted friend was also aware of the fact that the novelist had drawn a picture of her in her description of the heroine of *Romola*. A lock of deep gold hair, preserved among her letters to Hertha, conveys some impression of Madame Bodichon's beautiful colouring. Like Miss Marks, she scorned the hideous fashions of her time, and dressed in straight gowns with simple lines that set

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off her height and dignity. She was wearing one of these, made in tussore silk, on the memorable occasion of that first meeting in 1873; and Mrs. Ayrton used to describe in after-life how handsome Madame had looked that day, and how her admiration for her dated from that moment.

Mr. William Allingham, the poet, and his fiancée, Miss Paterson, were calling on Madame Bodichon, the same evening, and were asked by their hostess to go and look at her pictures in another room while she talked to Miss Marks. At this interview a mutual liking sprang up between the young girl and the older woman, which ripened afterwards into a warm and lasting friendship. Hertha's wish to try for a Girton scholarship was encouraged, and financial plans were discussed that might make a college career possible. In September of the same year (1873) the first of many visits was paid to Scalands, at Robertsbridge, near Hawkhurst, an interesting house built by Madame Bodichon on a clearing in a pine wood, and, like her dress and everything about her, a house that was defiant of conventionality. Designed after the model of an old Sussex manor, it was furnished with a simplicity almost unknown in the Victorian Era, though William Morris was then beginning to revolutionize house decoration. The latched front door opened straight into the living-room, the most striking feature of which was a bricked fireplace; plain white bookshelves formed a dado round the walls; matting covered the floor instead of heavy-pile carpets, and blue-and-white Algerian pottery—Dr. Bodichon, a Frenchman, had a house in Algiers where they used to spend the winter—added a touch of colour to the freshness of it all. There would be nothing remarkable about Scalands in these days of week-end cottages; but to Hertha Marks,

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with her great love of the country and of natural beautiful surroundings, the house in the wood must have seemed like a paradise when she went down to it from her toil and her cares in London.

"We are in a rough place, and strong boots and cotton gowns are appropriate," writes Madame Bodichon. "If you find after a week that you like staying with me, and can work in my house, I hope you will be free to stay longer; but pray do not come for less than a week." Her guest liked it so well that for the ten years or so that elapsed before her marriage she spent part of every holiday at Scalands, as well as countless week-ends. As for the thick boots, one gathers that this injunction was faithfully followed from a jesting reference to them in one of Ottilie Blind's letters, a year or two later: "I lay my admiration at your feet—clad, I fervently trust, no longer in those mammoth boots you used to wear!"

The Girton plan did not come into effect at once. Even if her mind had been free to concentrate on her studies, Hertha would scarcely have been ready to attempt a scholarship at once; and her mind was never free. The claims of her pupils had to be met before she could turn to her own work; and in her mental equipment, talented though she was, many gaps existed. But the main reason for the postponement of her college career lay in the demands made upon her by the family at Portsea. Studying the records of her daily life during those years of effort, 1873–6, one is left wondering that neither her strength nor her purpose gave way permanently under the strain she had to bear. She was often ailing, and very often dispirited; yet she never dreamed of shirking what she felt to be her duty to her family. When, in 1874, Winnie's health grew worse and she began to develop serious hysteria,

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the sister in London, against the wishes of all the friends who were ambitious for her, resolved to bring her up to town to live with her. It was a desperate undertaking and entailed giving up her afternoon paid work and staying at home to look after the invalid. In order to do this Hertha had to eke out her income by obtaining commissions for embroidery.

"I shall have to do the cooking and everything, so my hands will be full," she writes to Madame Bodichon, in October, 1874. And much as her friend disliked the sacrifice she was making, she at once helped to make it easier for her by giving her an embroidery frame, sending her work to do, and interesting others similarly on her behalf. "My letters to you always say the same thing," Miss Marks writes in gratitude for all this help. "They say thank you, thank you, thank you, and yet they never say enough to thank you! I received the Arab work to-day and the silks. . . . It is very unbusinesslike of you to pay me for undone work. Suppose you do not like it when it is done?" Her work was always too good, however, to be disappointing when done: she had an eye both for design and colour, and people soon trusted her to settle both for them, and gave her more commissions than she could execute. There was some idea, too, of her tracing designs for the De Morgan tiles; but this plan fell through. Generous offers of money from Madame Bodichon to help her to tide over the crisis in her affairs, were declined in one of her letters—"though it is very kind of you to make them."

Miss Blind probably expressed the mixed feelings of most of her friends when she wrote to Hertha in September, 1874: "My sense of justice strongly disapproves that a girl of your age should not only entirely support herself but also educate a sister, while my sense

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of generosity and moral beauty strongly approves." Madame Bodichon showed her affectionate concern equally, writing as follows: "I told Miss Orme that going to Girton would be a rest for you. I feared if you did not go soon you could not take it even as a rest, but would be floored altogether."

The heroic struggle was persisted in, until Hertha's health partially broke down in the summer of 1875, when an arrangement was made for Winnie to go to her Aunts' school (now moved to 5, Portsdown Road, W.), her fees being paid partly by her sister, who taught mathematics there, and partly by one of their brothers who was then earning a salary. Hertha was once more free to take as many pupils as she wished; and after living for a time with her friends, the Wards, at 9, Carlton Hill, N.W., she moved into a room of her own at 12, Bulstrode Street, W.

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CHAPTER IV

GEORGE ELIOT AND "MIRAH" (1875–6)

The interest taken by George Eliot in the higher education of women accounts partly, no doubt, for the fact that she was one of the first people to whom Madame Bodichon introduced Miss Marks, some time in 1873. An early donation to the fund for founding the women's college at Hitchin was a cheque for £50 "From the author of *Romola*"; and it was in allusion to this new departure of the women's movement that George Eliot wrote the well-known passage in her letter to Miss Sara Hennell that ended with the quotation—"*Si muove!*" "On the whole," says Mathilde Blind, in her biography of George Eliot, "she was more partial to the educational movement than to that other agitation which aims at securing the political enfranchisement of women." And J. M. Cross says of George Eliot in his *Life*, that—

> "She was keenly anxious to redress injustices to women, and to raise their general status in the community. This, she thought, could best be effected by women improving their work—ceasing to be amateurs. . . . Therefore George Eliot wished God-speed to the women's colleges. It was often in her mind and on her lips that the only worthy end of all learning, of all science, of all life, in fact, is that human beings should love one another better."

It can therefore be understood that George Eliot was ready to sympathize with the ambitions of the young girl in whom her intimate friend was so much interested; and Miss Marks soon became a familiar

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figure at the Sunday evening receptions held by Mrs. Lewes at the Priory, Regent's Park. Madame Bodichon refers to the music at these receptions in a letter to Hertha, in which she also speaks of a bonnet that Hertha had made for her:

"Mr. Lewes said last night—'I say, Barbara, we thought you never had such a becoming bonnet before, so original, etc., etc.' And he never guessed you made it till I told him! There was Federsi at the Lewes', and he sang superbly. Next Sunday, Salvini is going."

The suggestion has been made to the present writer that George Eliot contributed anonymously to the Girton fund that was collected for Miss Marks; but there is no direct evidence of this, though she certainly knew about the fund. "I went to Mrs. Lewes's yesterday," Hertha writes on one occasion to Madame Bodichon. "She and Mr. Lewes were very nice and kind. I told Mrs. Lewes about the plan for the loan, but could not quite make out whether she approved or not." This lack of expressed approval in one so sympathetic would be accounted for if George Eliot had been an anonymous contributor to the loan. Both she and Mr. Lewes were evidently anxious to be helpful in every possible way; for the following letter was written to Miss Marks from The Elms, Rickmansworth, on September 21, 1875, when Winnie had been temporarily disposed of and her sister was for a short time considering the possibility of a resident post:

"My dear Miss Marks,—I enter with the keenest interest into your needs—so does Mr. Lewes—and we are longing to see some avenue of light on the probabilities of your finding what will meet the rather difficult conjunction of requisites, especially as to salary and freedom from dogmatic prejudice. I have written to one lady, who I know will help us if she can. But I think I must give up the attempt to interest any one else until I have the opportunity of personal intercourse with our friends. I only send this hurried

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note to let you know that you have our sympathy, and that we shall be rejoiced if that sympathy can turn into practical usefulness. I certainly should have held it an advantage for you if you could have managed to make the necessary money by separate lessons and classes. The difficulties of the resident situation seem to me great. We leave this place on Thursday and are then going on a journey; but I hope we shall be at the Priory again by the middle of October. Yours always most sincerely, M. E. LEWES."

Apart from her general inclination to help Barbara Bodichon's protégée and her personal liking for Miss Marks, there was also a special reason why George Eliot should welcome the young Jewish girl to her house at this period. She was then engaged in writing *Daniel Deronda*, which appeared in the spring of 1876; and Hertha Marks, with her Jewish background and her pride of race, with her attractive Jewish personality and her interesting manner of singing or chanting in her pretty low voice the old Hebrew hymns she had learnt from her mother (she told a friend much later that once, under the influence of chloroform, she repeated these Hebrew hymns), must have provided just the touch of local colour that the novelist would find extremely useful, even if she had already planned the scheme of her book. It is often stated that Miss Marks was the "original" of Mirah in *Daniel Deronda*; but this assertion requires some modification. Hertha's first reference to the rumour occurs in a letter she wrote to Madame Bodichon, then in Algiers, on March 1, 1876, in which she says:

"The second part of *Daniel Deronda* is out, and Miss Orme says that Mrs. Lewes has drawn a young Jewess that is in it from me; but I have read that part, and I must say I cannot see the likeness. One thing she says of her, she did once say of me—that is, that her utterance sounds foreign from its distinctness."

To this Madame Bodichon replied on April 1, 1876: "You can tell Miss Orme that the little Jewess was

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written before you ever saw Mrs. Lewes, and she did not take one hint from you." This might seem to settle the matter if it were not for strong internal evidence to the contrary; and the probable truth of the matter is that Madame Bodichon correctly supposed the character to have been planned before Hertha's arrival upon the scene, but that she ignored the common literary practice of grafting upon an original conception actual features taken from a living person. It is clear from the biography of George Eliot that her interest in the Hebrew race goes back to very early days; for, on her first visit to London in 1838, the chief thing she wanted to buy was Josephus's *History of the Jews*. And in Mathilde Blind's *Life* it is mentioned that, "speaking on the subject of *Daniel Deronda* to a young friend of Jewish extraction"—(Hertha Marks?)—"George Eliot

"expressed surprise at the amazement which her choice of subject had created. 'I wrote about the Jews,' she remarked, 'because I consider them a fine old race who have done great things for humanity. I feel the same admiration for them as I do for the Florentines.'"

George Eliot's knowledge of Jewish life was endorsed by Miss Marks, in the following letter to Madame Bodichon:

"The description of the family of Ezra Cohen is absolutely true. Mrs. Lewes *must* have seen and known some Jews of that class; she could not possibly describe them so truly otherwise. One thing she forgot, and that was to make a strong smell of boiling oil (fish frying) round the shop when Daniel first went into it. 'Addy' must have been in the act of frying fish, as it was Friday. How often, when I was at Portsmouth, I have wished that Mrs. Lewes would see and describe exactly the life there, little thinking that she really would do it one day. The small Adelaide Rebekah, with her monumental features and her crinoline, is such a well-known child to me; I could name at least half-a-dozen of them among my own acquaintance!"

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There is little doubt that George Eliot used many of Miss Marks's personal characteristics in painting her portrait of Mirah. One of Hertha's intimate friends remembers well the picturesque woollen cloak that she used to wear in those early days; she made it herself, and it certainly resembled no other. This cloak is mentioned more than once in the novel, but especially in the first description of Mirah when she is found on the river bank by Daniel Deronda: "a girl hardly more than eighteen, of low slim figure, with most delicate little face, her dark curls pushed behind her ears under a large black hat, a long woollen cloak over her shoulders." George Eliot, writing to Madame Bodichon in reference to this passage, says: "I *wanted* you to prefer the chapter about Mirah's finding," from which it seems fair to infer, taking other internal evidence into consideration, that the writer knew there was a resemblance between her heroine and the young Jewish student whom they both knew and liked so much.

As to internal evidence, people who knew Mrs. Ayrton at all intimately at different periods of her life will be able to identify her with one or other of the following references to Mirah in the novel:

"... a low sweet voice, with an accent so distinct that it suggested foreignness and yet was not foreign."

"Mrs. Meyrick says: 'Her voice is just perfect; not loud and strong, but searching and melting, like the thoughts of what has been. That is the way old people like me feel a beautiful voice.'"

"Perhaps her ease of manner was due to something more than the simplicity of her nature. The circumstances of her life had made her think of everything she did as work demanded from her, in which affectation had nothing to do; and she had begun her work before self-consciousness was born."

"Mirah was not childlike from ignorance: her experience of evil and trouble was deeper and stronger than his own."

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The allusions of Mirah to her mother recall similarly Mrs. Ayrton's stories of her early life:

"One hymn she sang so often, so often: and then she taught me to sing it with her; it was the first I ever sang. They were always Hebrew hymns she sang. . . . My mother used to take me to the synagogue, and I remember sitting on her knee and looking through the railing and hearing the chanting and singing."

This passage might indeed have been taken straight from one of the accounts Mrs. Ayrton used to give to her friends of her childhood in the Jewish home, which was bound up in her mind with the figure of her mother and the religious observances to which Mrs. Marks attached so much significance.

The foundation of another literary friendship was also laid about this time. Miss Marks was staying with her friends the Wards, when she first made the acquaintance of Mr. J. R. Green, the historian, then a bachelor, whose wife—now his widow and a distinguished historian herself—became later one of Mrs. Ayrton's personal friends. "Agnes Ward knows Mr. Green, who wrote the *Short History of the English People*, and she has asked him to come to-morrow night, and I am going to stew some fish for supper," she writes with typical inconsequence to Madame Bodichon, in October, 1875. A couple of days later, she thus reports the meeting with Mr. Green:

"The first thing that strikes one in him is his manner, half paternal and half tender. The Wards are all very intimate with him, having known him fifteen years, so that I had a better opportunity of seeing his real character than if there had been strangers present. He seems to know a number of people with names, and as far as I can discover, the girls of his acquaintance literally sit at his feet and worship. . . . His conversation is most interesting, without being very original. He talked a good deal about Emanuel Deutsch, whom he knew, which was very interesting to me. He also said in an impartial kind of way: 'I should smoke, but I have

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two natures, one nervous and excitable, the other strongly self-indulgent. If I once began to smoke, I should sit in a chair and read, and never do what I hate, namely—produce.' "

This was the first of several meetings, and we find a reference in one letter to Mr. Green's admiration of the Arab embroidery that Hertha was doing for Madame Bodichon.

Among the new pupils she obtained this year (1875) was the little daughter of the Hon. Roden Noel; and a great liking sprang up at once between Miss Marks and Mrs. Noel. The whole family, indeed, seem to have fallen under her spell, especially the younger son, Eric, who adopted her with all the thoroughness of childhood. She often stayed at their pretty home, Maybury, near Woking, where she went for the first time during the Easter holidays of that year; and the following letter, written to her by Mr. Noel just after her visit, will interest those admirers of his who think that his poems have never received the notice they deserve:

"DEAR MISS MARKS,—I have directed my publishers to send you a copy of the *Red Flag* as I promised. Will you read, when you have leisure, the poems I proceed to name? I shall like you to read them and report your impression to me, as I find from talking to you that your impression of things is not without real value. . . ." (Here follows a list of some twenty poems.) "My place as a British poet is to my own mind of course not doubtful, or I should not go on writing; and my conviction is confirmed by those for whose judgment I most care; nevertheless, I find it difficult not to wish young people, especially those with whom I have sympathy, to care a little for the chief work of my life; and I fear I may make myself troublesome in this way sometimes. I trust you may not find me so! Read also the essays on Byron. I am sorry to say that with the man I have more sympathy than I approve of yourself for having. I know so well—as he knew—the fierce struggle between the strong natural prejudices of the aristocrats and the convictions of the democrats, which are so skilfully painted in the "Spanish Gipsy," and which alas! issue in inconsistency;—so

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the essay is sympathetic, and I have been told painted Byron as he was. . . . Mrs. Noel sends her love. Believe me, Yours very truly, RODEN NOEL."

In a later letter, Mr. Noel writes:

"By the way, why do you direct to Mrs. Noel and to me without our title of Honourable? If you do this from Republican scruples, I can sympathize with your motive, and shall acquiesce most willingly in your practice; for in an ideal state of society I quite think *there should be no titles*. But my feeling is that the idol of race and of birth is *less* of an idol than that of wealth, and that in this country it is as well, till people are better and wiser, to play off one against the other. Now, a title is a sort of visible sign of birth, if it is hereditary. As you rightly value yourself on your race—or are you too proud to care from whence you came?—I suppose you can enter into this weakness of mine a little, especially as you say you can sympathize with my fellow-feeling for Byron in a similar respect. I shall, however, gladly acquiesce in an abolition of titles by law to-morrow; but while they exist, I use the one I have a right to by birth, chiefly as a sort of armour against stupid people who have money, and other stupid people who have titles."

Unfortunately, Miss Marks's reply to this communication is not extant. As a contrast to so scholarly a correspondence the following letter is perhaps worth quoting; it shows the degree of intimacy that prevailed between little Fanny and her governess, if it also suggests incidentally that spelling was not one of the subjects they studied together:

"MY DEAR MISS MARKS,—Thank you very much for sending the *Crofton Boys*. It looks a delisush book. It was Mamma's burthday yesterday, we arranged our preseants all in flowers they looked very pretty, then in the afternoon we went to the cops and found a splended cave mad by the colage boys so we at once went in, Papa and all but Mamma. . . . After that we went on to the stream and played about, Conny [1] and Eric putting sticks through the hols in the bridge and seeing them float away, then we went home and we found that a cake had been made with sugar on the top. . . . Eric sends a kiss and so does Conny. We do

[1] Now the Rev. Conrad Noel, Vicar of Thaxted, Essex.

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Arithmetic every afternoon when Mamma has time. I have not done much work. I have drawn two crocuses and began a dafadil. From Yours aft. FANNY."

Mrs. Noel's long correspondence with Hertha Marks, which began in 1875, opened with an attempt to create in her that religious faith which was an integral part of the older woman's nature. It is some indication of the affection between them that her failure to do this seems to have had no deterrent effect upon their friendship. Their letters discuss quite frankly the differences between them, and tolerance on both sides made it possible for each to appreciate the other's point of view. "I can sympathize so much with your difficulties," writes Mrs. Noel on April 10, 1875, "for I know how puzzling all the different opinions and beliefs must be to one who is thinking of and searching for Truth." On her side, Miss Marks diligently read the New Testament that was sent to her, and went to hear Mrs. Noel's favourite preachers from time to time, though without yielding to more than a frank recognition of the beauty of the gospel and of the humanity of Christ. It is characteristic of her that her own account of these early talks on religion were summed up briefly in a letter to Madame Bodichon, written during her first visit to Maybury, and embodying what was (from her point of view) a real compliment to her hostess: "I had a long talk on religion with Mr. and Mrs. Noel to-day, and Mrs. Noel is much less religious than one would imagine."

It can be gathered from Hertha's correspondence with Madame Bodichon that religious doubts never seriously assailed her again after she lost her Hebrew faith at the age of sixteen. At twenty-one, she was, however, occasionally troubled by moral and ethical problems, all of which she at once presented to Madame Bodichon for elucidation, in letters that are delightful

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to read because they were evidently written straight off without the least self-consciousness, under an impulse to tell the recipient everything, large or small, that happened to her. She writes, for instance, on October 28, 1875:

"Every day now, more and more, I am feeling the want of a guide in the way of principle. Every question of morality presents itself to me, to be traced back to utility. If I had time, I should like to do this for myself, but I haven't, so I want very much to get a book on the subject. Though I threw off my religion five years ago, yet I have never realized this want so distinctly before. But now, every day it presses on me, and I must find some way out of it. Life will be altogether too difficult if, every time a question of right and wrong arises, I have to trace it to its source. Hitherto instinct has guided me, but now reason is continually saying to me: Why is it right? I am not referring to questions about my own conduct; they rise so seldom that it is not difficult to solve them."

In another letter, she discusses a book she has been reading by an American writer, Mrs. Evans, "who writes very bravely, handling subjects which most women would avoid, with a delicacy and modesty which make one admire her; but I think she takes too much for granted." This criticism is provoked by the author's condemnation of fœticide, as to which Miss Marks confesses: "I am in great doubt on the subject, because she does not prove that it harms anyone particularly, and it does not seem to me a dangerous thing to do." To this Madame Bodichon replied with a rare promptitude—as a rule, she was the worst of correspondents—saying: "I think that fœticide is a crime; it is false to say it does not injure the health of the mother; Dr. Blackwell and I have talked of this, and I will tell you her opinion."

In every possible way Madame Bodichon befriended the girl, to whom the friendship of an experienced

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woman of the world, especially one so wise and distinguished, must have been invaluable at this impressionable period of her life. The house at Scalands was always open to Miss Marks if health broke down or a holiday occurred; and its owner was as ready to offer a loan of money as to offer books or advice or anything else that seemed to be wanted. From the first the intercourse between these two was characterized by a sympathy and frankness that made it possible for Madame to proffer criticism and advice without the slightest fear of being misunderstood; and a sense of humour on both sides helped to perfect their relationship. When Hertha writes gloomily about a school appointment that has been unaccountably offered to somebody else instead of to her, Madame writes back as follows:

"I think 'c'est inutile de compliquer les hypothèses,' and I should say Mrs. Y. has some one in the house she wanted to employ. . . . I think the hair is an objection, and as I told you before, if you put it in a net when you go out to give lessons it would be worth £50 a year to you."

To this, Miss Marks replies: "I will wear a net or anything you like to get pupils, only I am certain I shall look so ridiculous that I shall get still fewer pupils; it really is not because I mind looking uglier than I was intended to be that I hesitated to wear one!" In the same spirit, Hertha receives rebukes about her "childishness" in not taking more care of her health, in forgetting to put a pocket in the dress she is making—a real omission in those utilitarian days!—in not eating enough nourishing food, and so on. "You are my fairy godmother and my prince," writes the girl, one day, in fanciful mood; and another day she declares: "The more I see of other people, the more I feel sure there is no one else at all like you; no one so good and clever and having so many interests and caring for

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so many people." In some ways their relationship resembled that of a mother and daughter; and the greatest test of their friendship, and the one that it triumphantly bore, was that no money transaction ever affected it all through the years that it endured.

When Winnie was for the moment off her sister's hands, in the autumn of 1875, Madame Bodichon revived the Girton plan. "It may be counted as one of Madame Bodichon's many benefactions to the College that she made it possible for Miss Marks to become a student," says a writer in the *Girton Review* (Michaelmas Term, 1923). Without Madame's help the thing would certainly have been impossible. She lent the major part of the sum required, and, although every penny of this loan was afterwards repaid, she had no security for the debt—except the only security that is, perhaps, worth having, the pride and honesty of the borrower. Undoubtedly, there were gifts, too, from the same generous source; and it was of course Madame's example that helped to produce further contributions to the Girton fund, which might not have been forthcoming if the recipient had not been introduced by Madame Bodichon. Some of these contributions were loans; and a few Jewish friends, including some who knew the Marks family at Portsea, helped indirectly by paying part of Winnie's maintenance. Miss Orme, who had now passed her examination in Roman law, acted as intermediary for all these financial transactions; and Mrs. Dicey, Madame Bodichon's cousin, collected various sums, including a substantial gift from a friend, who preferred to remain anonymous and is always referred to in the correspondence relating to the fund as the "unknown." "She wishes me to tell you," writes Mrs. Dicey to Miss Marks about this particular subscriber, "what a pleasure it

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will be to her to feel that she can procure for you any benefit in the way of education such as she happily can give to her own children, and such as she says was lavished on her in her youth."

During the first six months of 1876, Miss Marks was working hard for her scholarship examination. Her letters to Madame Bodichon, who was in Algiers until May, speak of various other activities: of a debating club in which vivisection and women's wages are discussed, of reading Molière with the Shore-Smiths, of teaching the Noel children, of interesting meetings with Girton students — Miss Townsend and Miss Müller, among others. All this time she was living alone in Bulstrode Street, greatly against the wish of Miss Orme, who seems to have presumed upon the kindness she undoubtedly showed in other ways by taking every opportunity to scold her, though without much effect, as may be gathered from a remark in a letter of Miss Orme's to Madame Bodichon: "I fear our student will never stand much work, more especially as she has 'views' which prevent her taking advice."

Miss Orme was right, in so far as Hertha's health was concerned, for as the time of her examination approached the strain became apparent; and once or twice she had to knock off work altogether and go away, generally to the Noels at Maybury. The death of old Mrs. Moss in April further complicated matters by upsetting the financial arrangement Hertha had made with her brother for Winnie's support; for the brother's contribution had to be diverted to defray home expenses. Miss Marks wrote to Madame on April 8, 1876:

"I can translate two pages of Xenophon now, twice a week; and Mr. Walker seems to think I am all right about my Greek, but I don't feel as if I were all right about anything. The nearer I get to my exam, the more sure I feel that I shall not get the scholar-

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ship. The kind of work wanted for examinations is, I am sure, not the kind I can do. . . . Besides, I'm sure I shall lose my head in the exam-room. Altogether I am not in a lively state of mind about myself. . . . Will you lose all your faith in me if I don't get it?"

Madame's answer to this is as follows: "I shall be sorry if you don't get £300, but if you don't, I shall try to get the £150 for you, and I shall never think less of you in some ways, though of course I shall think I over-estimated you relatively to the other students. *Have you good food?*"

On May 1, Hertha writes again to her in Algiers:

"I have been very unwell and was ordered by Mrs. Anderson to go away for a few days, so I have come down to Mrs. Noel's. I had neuralgic headache, Mrs. Anderson says from overwork. I am afraid this quite takes away my chance for the £300, but I still may get £150. Thank you very much for your comforting assurance that you will try to get the other £150 for me if I do. In myself as a competitor at exams, I have lost all confidence, now. . . . The nearer I approach it, the more horror I get of my exam. I get quite paralysed sometimes at the thought of it. Yet I am sure that I am capable of hard work, and I feel that I have the power to understand and learn almost anything, as long as I have not my nightmare before me; but directly I have, my work is not so good. I wonder where you are at this moment? I hope you have been careful to keep out of the way of the revolting Arabs. I had a letter from Marcus and Blanche, the other day, in which M. consults me with regard to the education of his child. It is great fun!"

The examination was held at Burlington House on June 30, and Miss Marks won neither of the two scholarships. It was clear that her health, as well as the short time she had allowed herself to prepare for the examination, had much to do with this result; for she writes thus to Madame on July 11, 1876:

"I will begin my letter with what I know you care most about, the doctor's verdict. He said that I have not entirely spoilt my constitution, and that I *shall* be a good worker. But I must rest entirely until October, living in the country, being as constantly as possible in the open air. I asked if I might go to the X——'s,

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if they wanted me, and teach the children two hours a day, and he said Yes; but that is the utmost I may do. . . . I want to thank you for my visit, but I can't. How can one say anything to express thanks for acts of kindness that occur as often as you breathe? You can't tell how happy I was with you, even in spite of my disappointment about the scholarship."

In the same letter, she relates another meeting with Mr. Green, the historian:

"I went to the Wards on Sunday and Mr. Green was there. Being rather ashamed of myself, I did not want to speak to him and avoided him. But when I was walking in the garden with Agnes, he came up and said, 'I want to speak to Miss Marks, so will you leave us?' She did, with some astonishment; and after apologizing, he said he thought I must be disappointed about my exam, and went on at some length, trying to make me believe that I was too original to do well in exams. It was very kind of him; he said that all I wanted was to believe in myself and to work. He thought I required the severe discipline of working at Girton, that it would be of the utmost use to me, but that probably I should not do well in any of the exams. He said lots more, and it really did encourage me a little to be spoken to like that by a man like Mr. Green. But I remembered what you said, about my believing too readily that people meant a great deal by a few words of praise —though he declared he meant every word he said, and I think he did at the time."

Mrs. Dicey wrote to Madame to say that she was sorry for Miss Marks's disappointment, "but not in the least surprised"—adding that her failure would make no difference to the sum promised by the "unknown." In the end, sufficient money was either collected or guaranteed, and on July 19, 1876, Hertha wrote jubilantly to Madame, saying she had heard from Miss Emily Davies that she was entered as a student of Girton.

Meanwhile, it was necessary to get strong before October; and she accepted the holiday engagement at the X——'s, having first seen her doctor and received a favourable verdict on her health.

The holiday engagement was only a partial success.

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Perhaps, the news of Ottilie Blind's engagement to Mr. Charles Hancock, coming as it did just as she left town, may have depressed her unconsciously, in spite of her genuine delight in her friend's happiness. But more probably, she and the X——'s found one another mutually difficult to understand. She writes to Madame on August 1, to say that—"There is a field and a cow and a calf and a garden; but it seems to me they live as much an indoor life as if they were in London. . . . I hardly knew till I came here how unique your and Dr. Bodichon's way of being in the country was!" Her criticism becomes more pronounced in her next letter, dated August 11:

"Everything goes on quite quietly and well here, except that my pupil, and indeed all the family, look down so intensely on people who have not long pedigrees that it makes me angry sometimes to hear them talk. I generally hold my tongue when they do so, but this morning at breakfast they began talking about some rich vulgar people who live near here, saying it was impossible for their daughters to be ladylike. I couldn't help saying that I did not think being ladylike depended upon their birth so much as on their education and natures. Then I said that my own father was a watchmaker and carried watches about the country to sell, and I thought for all that I knew how to behave as a lady. I know you will think I oughtn't to have said so, because perhaps I don't always behave like one; but F—— provoked me to it by saying that people always tried to hide their low birth; and besides, I had made up my mind to tell them at some opportunity, because I don't like being talked to as if I were what I am not. . . . Now, it seems to me that this is a kind of difficulty I shall often have to encounter, and when you have time, I should be very glad if you would write and tell me your thoughts about it. I am sure you believe, though every one wouldn't, that my opinion on this subject is not founded on my own low birth, but is a natural outcome of my whole theory of life. . . . Nevertheless, I am very happy here, because, opinions apart, they are very pleasant people, and are all *extremely* kind."

Madame Bodichon's reply is interesting in many ways, and contains a reference to George Eliot: "My

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dear Marquis," she writes—this nickname was a French form of "Marky," which was what she always called Miss Marks—

"I think you told your friends about yourself too soon. You should have been sure they liked you and thought you a lady first! It is quite right to tell, if it seems important; but I think it better to say to some of your true friends (like Mrs. Lewes and me) that you do not wish to make a secret of your parentage. Dr. Bodichon insists that your Jewish birth is noble parentage. Yours is an unmixed race; you are not mongrel as we are. Be content to say you are pure breed and become in yourself a true gentlewoman. We are going on well here in all ways. My blessing and my love. I send you a present by book post. Yours, B.L.S.B."

Although there continued to be little in common between the X—— family and their holiday governess, so that Hertha called her sojourn under their roof "a fit punishment for a person who overworks," there was one bright gleam in her visit—a prophetic gleam, too!—which she thus narrated to Madame: "I am not half so wearied now, for the youngest boy is making a model (stationary) steam engine, and I am helping him, and it is very jolly."

At the end of the summer holidays, she returned to town, then spent a few days at Scalands, and at last realized the dream of her girlhood by going up to Girton in October, 1876.

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CHAPTER V

GIRTON AT LAST! (1876–7)

When Hertha Marks went up to Cambridge in 1876, Girton College, originally founded at Hitchin in 1869 with a nucleus of five students, had been established just three years on the site that it still occupies outside Cambridge. It was yet a comparatively small institution, only about thirty to forty students being then in residence; but already some of the intense and perhaps self-conscious spirit of the pioneers was capitulating to the easy complacency of the "freshers," who were now coming up straight from school and were inclined to accept as a matter of course privileges that had been strenuously won for them only seven years before. Miss Lumsden, one of the original Hitchin students, admirably expressed in her speech at the Girton Jubilee, in 1919, what the feeling of the innovators had been, when she confessed to the present generation[1]: "I don't think we knew exactly what we wanted. . . . I know just one thing, that a divine discontent drove me on: I felt that the limitations of life were intolerable; and I was determined I would get knowledge. . . . I think the same feeling was in the minds of most of us. We had a sort of vision."

That first-year students, so soon as 1876, should be already growing indifferent to the victory gained for them at Hitchin in 1869 is a comment, not without

[1] See *Girton Review*, Jubilee number, 1920.

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parallel in our own time, on the ease with which the most hotly opposed reform becomes a commonplace when it is granted. But the indifference at Girton was instantly combated by Miss Marks. To her a college career was neither a commonplace nor the finish to a conventional education; and she sometimes surprised the other students of her year by speaking casually of "My seven years' experience of teaching," an evidence of maturity for which her youthful appearance had done nothing to prepare them. Her connection with Madame Bodichon, one of the actual founders of Girton, gave her, of course, a special position as a kind of link between the past and the present. Miss Kathleen Jex-Blake (afterwards Mistress of Girton, from 1916 to 1922), who came up as a very young girl in Hertha's third year, told the present writer how much Miss Marks did to keep before the new-comers a memory of the debt they owed to Madame Bodichon, to Miss Emily Davies and the other founders.

Those of her contemporaries with whom it has been possible to get into touch for the purposes of this biography are all agreed upon the kind of impression that Hertha Marks made upon them at Girton—invariably an impression of youth and vitality. "She was always the most striking figure among the students," said one of those who knew her at college. "Her brilliant eyes and great bush of curly hair were the features that impressed me most in her appearance. She was not ordinary enough to be simply popular; while some were intensely fond of her, others never quite knew what to make of her, and even in some cases found her actively antipathetic. But you could not ignore her, whether you liked her or not. She was very independent and never went out of her way to conciliate anybody, and she did not seem to mind much if they

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actually disliked her. I think her advanced opinions and her want of religion prejudiced some students against her—when she came up, the early sharp division of students into Evangelicals and Anti-clericals was only just beginning to break down—but I never heard her obtrude her views upon people."

Another student, older in years than Miss Marks, endorses the statement about her vivid personality. "I recall her as a very handsome young girl," she writes:

"with remarkably bright eyes and earnest eager face. She had a power of sparkling speech, and generally gave one the impression that she was one of the students of her year with a future before her. While other people have faded from my memory, it is always Miss Marks's happy face and ready suggestions that come before me as I try to bring back old days."

The following account, supplied by a correspondent who was a freshman when Miss Marks was in her third year, is useful as a picture of her at that period, besides accentuating her disregard for contemporary fashions in dress:

"My main memory of Miss Marks was seeing her slight, svelte, graceful figure going along the corridors in front of me to the dining-hall or a lecture room. I can see her still. Her hair, like her eyebrows, was quite black, of the 'fuzzy' kind that stood well out above her head. I think it must have been rather short, as she wore it just gathered together and the ends apparently tucked up and pinned underneath, at the neck. The style admirably suited her well-moulded features and delicate ruddy colour:—a handsome, graceful young woman, essentially a woman and not an over-grown girl;—not noticeably Jewish in appearance, for she might have been Southern French or Spanish. She wore a bodice, easily close-fitting, of either black or dark crimson velvet, high about the neck and set well off with a white frill, with rather loose sleeves to the wrist. Over this bodice she always wore, in my memory of her, a flowing robe of dark crimson cashmere that came about halfway up the bodice and had straps across the shoulders, then fitted in to her slender waist and fell in folds to her

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feet. It suited her admirably and was grace and dignity combined."

All who knew her at Girton mention her beautiful rendering of the old French songs she had learnt from Dr. Bodichon, which she used to sing unaccompanied. The same correspondent describes, as "a charming and fadeless memory," how she was once invited to "come to the stacks and hear Miss Marks sing." The College grounds then consisted mainly of fields, and close to the original Old Court were some hay-stacks partially cut for fodder. Here, on summer evenings, a group of Hertha's friends would climb up and sit round her while she sang "Chez mon père il y a un pommier doux" (the first line of the song "Les Trois Princesses"), "Jésus Christ s'habille en pauvre," and many others. She used to sing them also to a group sitting round the fire in her study on winter evenings. One may add here that the memory of her singing is equally "charming and fadeless" to many of Mrs. Ayrton's friends who, in later days, used to hear her sing these and other songs in her own drawing-room, very often in duets with her daughter Barbara.

Her first college letter to Madame Bodichon, headed "Girton College, 7th Room, 3rd Corridor," and dated October 18, 1876, seems to verify the predictions of her friends that Girton would come as a rest to her after the strenuous life she had led as a teacher:

"I believe I have got into full swing now, but in spite of that, I have barely enough work to occupy me for five hours a day, the time Dr. Bastian allows me to study. . . . This air agrees with me wonderfully, and my appetite is becoming amazing. I really am ashamed of eating as much as I do! I go out at least an hour-and-a-half a day, and altogether, what with the air and regular work and everything, I am already beginning to feel quite a different being. . . . I am going to write to the 'unknown' on Sunday and tell her how much I like being here, and how happy I am. I have

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two half-hour lessons a week in Latin, an hour-and-a-half in Greek; three half-hours trigonometry, and three hours algebra. . . . I am reading Malthus on population as a book of amusement, because it is amusing enough to take my thoughts off my work, and not exciting like a novel. . . . The question for the next debate is to be, 'It is expedient that, in the present state of civilization in England, the ties of blood relationship should involve some duties.' Miss Müller is going to oppose, and we expect great fun from it. . . . As I cannot put up my pictures this term, on account of possible dampness of walls, I am going to paint sunflowers, lilies and ox-eye daisies all over my walls, and I am going to try my hand at making frames for my pictures. With love, Affectionately your MARQUIS."

In her answer, Madame Bodichon assures her that until she weighs nine stone she cannot eat too much, tells her how to mix distemper and cut a stencil for her wall decoration, begs her to give both Mrs. Dicey and the "unknown" some idea of the joyful life she is leading, "because people think we urge you to work too hard"; and ends with the item of news: "Mr. Thomas Taylor gives £1,000 to Girton in memory of his daughter."

Further passages from letters written by Miss Marks to the same correspondent, during her first term, are as follows:

"(October 30, 1876.) Miss Scott and I know more than the others; she knows most of all, but I manage to do the same work. The person I am most intimate with is Miss Borchardt. The new building is going on very well, but on the top corridor of the new part they have cheated us of our windows, and the consequence is a long bit of blank wall outside, which is very ugly. Directly you have finished this wing, you will have to begin on some more, for there are so many more girls coming that I am sure there will not be room for them. As it is, one girl lives in the prayer-room, and two others share a room. I am the only heathen of my year, out of eleven students. After that, let people declare that ours is a secular college! . . . The College is most decidedly divided into the religious set and the non-religious, and I don't know how they are to amalgamate, for they are like oil and water. This matters much less now than it did, and the more the College increases,

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the less it will matter. I know some of both parties pretty well, but I don't see the least chance of their coming together, for the religious party is a childish, school-girlish set and seems to have nothing in common with the others."

"(November 15, 1876.) We are making great preparations to amuse Miss Borchardt before her Tripos; there is going to be a fancy ball; we are going to act the *Rivals*, in which I am to take the part of Lucy. . . . Ottilie and Charlie came and stayed till Monday in Cambridge. They are both looking remarkably well and seem to be enjoying life generally. . . . I had a lot of the students to tea, and Miss Bernard [1] invited Charlie to dinner, else he could not have remained."

A great disappointment was to follow this happy beginning at Girton. The illness of the preceding summer had not, after all, been successfully overcome, and all the pleasant distractions of her first term did not suffice to stave off a still worse breakdown in health that occurred in January, 1877. A rest was prescribed as the only means of ensuring the completion of her college course, and this was made possible by the kindness of Madame Bodichon, who came to the rescue once more with financial help, hospitality and commissions in embroidery, so that Hertha was able to go down from Cambridge for two terms and to remain in the country most of that time.

A contributory cause of her illness may have been the shock caused by the tragic death of little Eric Noel. The two had kept up an entertaining correspondence since Hertha's first visit to Maybury, Eric's share in it being dictated to his mother; and the following extract from a letter written by Mrs. Noel to Miss Marks, a year later, shows how promptly the latter had hastened to Maybury on hearing of the child's illness:

"I hardly ever think of *him* without thinking of you too. He was your dear little friend and loved you so much. I so often have

[1] Miss Bernard was Mistress of Girton, 1875–84.

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his pale tired patient little face before me, the night you arrived at Maybury, when he was ill. He was lying on the sofa, and he was so quick to hear the fly when you drove up, and said: 'I *fink* I hear the fly; perhaps it *is* Miss Marks coming.'"

Another letter from Mrs. Noel, written two years later from San Remo, whither she had been driven for the winter by her own delicate health, contains an interesting reference to the same sad event:

"Roden has written a great many poems about our darling, and would much like you to see them. I will try and copy them soon and send them to you. They are of course only for private circulation[1]; but we should particularly like you to have them, knowing how he loved you, and you him. How often I hear his sweet voice calling 'Miss Marks!' and how often he said to me: 'Mama, ven *are* you going to ask Miss Marks again? *May* she come?'"

Miss Marks stayed at the child's bedside until he died, writing thus to Madame on January 11, 1877:

"My little Eric died last night at half-past nine. I would rather tell you than write about it. I hope I was as much use to Mrs. Noel as a stranger could be, but it has been very dreadful. I tried to do everything I could for all of them, but you will understand how little that can have been."

Madame's reply, written from her town house, 5, Blandford Square, N.W., was simple and characteristic:

"My dear Marquis,—I am *very* sorry. Will you like to come here when you come up? I am sure you must have been a great comfort. Your loving B.L.S.B."

The invitation was gladly accepted, a friendly compromise being effected with Ottilie Hancock, then in Upper Gloucester Place, by a division of Hertha's visit between the two who principally claimed her in the holidays. The nervous breakdown occurred almost

[1] These poems were published in 1881 by Messrs. Kegan Paul, under the title of *A Little Child's Monument.*

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immediately, and we find Miss Marks during the next nine months staying in various places—in rooms at Eastbourne in February, at Portsea for Passover, at Scalands in April, and after that, at Lea Hurst, Derby (Miss Florence Nightingale's old home). Here she had a holiday engagement for the summer, her pupil being a niece of her hostess, Miss Julia Smith, who was the "Aunt Julia" of Madame's letters, for she was aunt both to Madame Bodichon and to Miss Nightingale.

At Scalands, while Madame was away in Cornwall, Miss Marks enjoyed the companionship of Madame Belloc and her two children (afterwards the writers, Mr. Hilaire Belloc and Mrs. Belloc Lowndes). When she went on to Lea Hurst, she received the following letter from Madame Bodichon, dated May 4, 1877, the last that Madame was to write for some time; and for that reason, as well as its interesting reference to an early form of typewriting machine, it is quoted here:

"I can't tell you how much I like this place, but as for drawing, it has been too cold—colder than it was in March. . . . I think the machine is a great success, but like all machinery it wants a head to keep it up to the mark. It would not be worth £20 to any one who had a free right hand. The 'manifold copier' is carbonized paper put on the roller, the inked ribbon being taken out. That ribbon is the devil to manage because it gets ruffled and cross. . . . I am very glad you have a pocket; it makes you much more useful to your fellow-creatures, and saves me from real annoyance. I do love daffy-down-dillies; here we have bluebells and wind flowers everywhere. Love to Aunt Julia. Yours affectly., B.L.S.B."

Almost immediately after writing this letter, Madame Bodichon had the very serious illness that prostrated her for the rest of that year. Hertha's anguish of mind, occasioned both by her anxiety for her friend's life and by her distress at not being allowed to go to St. Ives and nurse her, can be gathered from her letters to

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those who were with Madame at the time. She writes as follows to Madame Mario,[1] the friend who, with Madame Belloc, was in charge of the sick-room:

"I ought not to have been disappointed at your telling me not to come down, yet I could not help being so. . . . If Madame Bodichon were my mother I should have a right to come, yet I can do nothing for her. I am so very glad Madame is in such good spirits, but she *always* does exactly the right thing, so I do not wonder."

Miss Marks contrived to keep all evidence of her anxiety out of the letters she wrote almost daily to Madame Bodichon, some extracts from which will serve as a chronicle of the writer's daily life during June, 1877:

"(June 8, 1877.) We have been all over Mr. W.'s mill to-day. . . . It is one of the most wonderful sights I have ever seen. . . . The economy of labour is so great that it almost strikes one with awe. One young girl manages three great machines for spinning gussets for ladies' jerseys. This machine is one of the most wonderful. One ought to put the stone arrow-heads you have beside one of these almost reasoning things, to see the stride man has made in implements. I wonder if we are capable of making as great a stride again? . . . I should like to be a mill girl for a year, going through all the different kinds of work, and studying the engines till I knew them all thoroughly."

In the same letter, an allusion to the conditions under which the mill girls worked shows that, even at this early period, Miss Marks never allowed her interest for the machine to blind her to the greater claims of

[1] This Madame Mario (1832–1906) had had an interesting career. Her maiden name was Jessie White, and she applied, unsuccessfully of course, for admission to the University of London as a medical student even earlier than Miss Sophia Jex-Blake or Miss Elizabeth Garrett. She then went out to Italy to nurse the wounded under Garibaldi, and there met and married her Italian husband. She was a widow at this time (1877) and one of her characteristics was a love of smoking very long cigars.

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the human being behind it. "When I saw the girls standing in those great hot fluffy rooms," she continues,

"or sitting on forms without backs, slaving, it struck me that no one who had not lived the life could understand its peculiar hardships and temptations, and that they must feel it very insulting when ladies, who as far as they can see need do nothing from morning till night but amuse themselves, talk to them of improving their minds in the evening and of not indulging in their one pleasure, gaudy dress. . . . What can one expect from them under such hard circumstances? For my part, I feel that if I were a mill girl, and a *lady* began talking to me in the patronizing way in which ladies who help 'the poor' generally do, I should turn round and ask her if she had worked at a mill, and tell her not to talk of what she knew nothing about. All religions have been formed and forwarded by poor men, not men who talked of the sins to which they had no temptation. At least Christ lived among, and was of, the people he taught, and that was one of the greatest reasons for his success;—I mean, that is what I think!"

"(June 15.) Do you know that if you look through an alpaca umbrella in the sun, you will see thousands of tiny stars of all colours on a black ground? . . . I suppose the tiny hairs of the alpaca form prisms, through which one sees the light admitted through the holes. I am more inclined to think this because, if you look through a silk umbrella, you see nothing but ordinary sunlight. I shall try a few more experiments with different kinds of stuff to make sure of this."

"(June 16.) I am getting very much interested in my Greek play (Hippolytus) now I begin to read it more easily. It is very beautiful, and I think there never was a more beautiful language than the Greek. In the Testament, yesterday, I was very much struck with Christ's telling his disciples, when they went on their journey to preach, not to provide raiment or food, 'for the labourer is worthy of his hire.' It was taking such a just, wholesome view of things. I suppose it is all old to you, but to me it is new, and I am glad to read it for the first time in the original language."

"(June 20.) I have just written to Mr. William Morris, to ask him whether or not he is going to give me any embroidery to do, because we are to be in London in ten days' time."

In another letter she again refers to William Morris:

"I had a letter from Mr. Morris on Friday evening, saying he had an *important* piece of work to give me to do for which I was

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to call on Thursday. Isn't it nice of him to give me an important piece the first time? I saw Mrs. Dicey, and Joan Bonham-Carter was there—such a sweet-looking girl. Mrs. Dicey and the 'unknown' had been trying to get me some teaching, before Mrs. Dicey knew about the embroidery and my coming down to St. Ives. It was very kind, wasn't it? People *are* so kind."

At the beginning of July she at last secured what Madame Belloc in one of her letters calls her "heart's desire," and went down to Cornwall, having first written impulsively to Madame Mario: "I *won't* let my words tumble over one another, I won't do anything I ought not; and I will do everything that is best for my dear, dear Madame!" Evidently she kept her word, for she was allowed to remain with Madame Bodichon during her convalescence, and left the invalid materially improved in health when she herself returned to town, in September, for an important family event—the marriage of her cousin Nelly (Helena Hartog) to Professor Arsène Darmesteter, the brilliant occupant of the Chair of Literature at Paris University. It was at this wedding that the first meeting took place between Miss Marks and the bridegroom's younger brother, Monsieur James Darmesteter, afterwards Professor of Oriental languages. Whether the foundations of their later friendship were laid then or afterwards is not certain, for the earliest letter in existence from M. James Darmesteter to Hertha Marks bears a date four years later; but it appears from a passage in one of Mrs. Hancock's letters, written soon after the wedding, that the sympathy between the two was felt the first time they met.

In October, Miss Marks went up once more to Girton, and her letter to Madame Bodichon, dated October 14, 1877, is ecstatic:

"Here I am in the dear old room again (the same that I had before), sitting at my study table and feeling as if I had never

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left it. It is very delightful to be back again, scrambling for breakfast, quizzing lecturers, and talking shop from morning till night! . . . Among freshmen, Miss Z——, scholar of her year and daughter of a draper at Y——, seems clever. I hear that some students look down upon her because of the shop, which makes me feel inclined to proclaim my origin from the house-tops! . . . That last afternoon with you made me so happy. I think hardly anything could make me really unhappy except estrangement from you!"

Other letters written during this October term, giving a picture both of Girton at that period and of Miss Marks's life there, contain the following passages:

"(October 28, 1877.) We had the first meeting of the Girton Choral Society last night, under our new leader, Miss Tuthill. It was such a delight to be singing in chorus again; it is perfect heaven to me to do so. The Debating Society have put off the debate which was to have been on Monday night, to next Wednesday, because some of the students are going to a *cooking* lecture, of all things in the world!"

"(November 4.) All this week I have been very much absorbed in inventing (I ought not to call it that, because I believe some one else has done it before me) a sphygnometer—which means a pulse measurer. Isn't it a lovely name? At least the other person's thing is not *called* that! It consists of a spring made from the old mainspring of a watch, which fastens round the wrist, and the lightest and most springy part goes on to your wrist just over the pulse. The pulse moves it, and a paint-brush which is fastened to the spring moves up and down with it. Then you draw a piece of paper along, touching the brush, at as uniform a pace as possible, and the brush makes undulations on the paper for each throb of the pulse, so that if it makes 70 waves a minute your pulse is 70, and so on. I am afraid you won't understand from this explanation, but I will show it you when I see you. . . . I wonder if you know what very nasty stuff Paley's *Evidences of Christianity* is to get up, and how very horrid Mr. Carr is, who gives us papers on it?"

"(November 13.) I am getting busier and busier, but I think I may just get through my Little Go by chance. The Latin is the bother; it is so unfamiliar. Greek verbs are my great triumph, irregular and otherwise! . . . Last Thursday, we had a jolly dance in Hall, from 9 till 10. I suppose you know pretty well what the scene is like—some in 'gym' costume, some in gorgeous dressing-gowns, and a few in ordinary dress. . . . On Friday night, Miss

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Bennett and I, for want of better exercise, had a wrestling match. To my own astonishment and every one else's I got her down in a minute. Then Miss Ker came; she was disposed of in the same way; then, as I got very uppish over my victories, some one fetched Miss Arthur, whom they supposed it would be more difficult to conquer, but down she went too, at once. Then I offered to let her have the advantage by allowing her to clasp me round the waist to begin with; in this way we had three rounds, lasting about two minutes each, and at last I was conquered."

"(November —) Darwin took his degree in Cambridge to-day. Miss Bernard and Miss Herschel went, but no one else; and all I can tell you about it is that the undergraduates let down a stuffed monkey and the 'missing link,' whatever that may be!"

"(December 10.) At last, dear Madame, one half of the Little Go exam. is over—the mathematical part. But the worst is still to come—the classical. By the amount we all did in the mathematical, I believe we are all sure of a first-class. . . . On Saturday we went in to Cambridge with Miss Welsh to have the *viva voce* part of our exam. (Latin), and most of us, I among them, got full marks for it. . . . On Saturday night the Moral Science lists were out, Borchardt and Arthur second, Müller third. This is as high as any of them were expected to come out, but I believe both Miss Arthur and Miss Borchardt might have got firsts, the one if she had written legibly and not been so dreadfully Hegelian, the other if she had worked more than three hours a day, and had not missed nearly one whole paper through being ill. The College was very delighted at the news, and chaired them; and we cheered till the place rang again."

Miss Marks was placed equal to the First Class in her Little Go, a place that she shared with Miss Sheldon and Miss Pailthorpe, the remaining three students who went in with her being placed equal to the Second Class. That she did so well can probably be attributed to the fact that this was the only examination she ever attempted after a long rest and with a comparatively free mind, her family being for the moment in a rare state of quiescence.

She spent her Christmas vacation with Madame Bodichon at Hastings, and received the following

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letter there from George Eliot, dated December 25, 1877:

"DEAR MISS MARKS,—Your good news about our dear Madame Bodichon was the best of Christmas gifts to me this morning. . . . I shall be delighted to see you when you come to London, but do not call before half-past four, as I am always out between lunch and that time. I long to have more minute details about Mme. Bodichon than a note can give me. But that she has a drive and walk every day is at least a starting-point for pleasant fancies about her. The *Voyage of the 'Challenger'* is a splendid book, is it not? Your own studies and health have been going on well, I hope. But you will tell me everything when I see you. Affectionately yours, M. E. LEWES."

"I saw Mrs. Lewes on Monday," writes Miss Marks to Madame Bodichon, early in the following year, "and Mr. Lewes advised me to work for a place in the Tripos, but I shan't; it wouldn't be any use." At the end of January, 1878, she went up to Girton for what was in effect the remainder of her first full year at college.

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CHAPTER VI

COLLEGE YEARS (1878–80)

Her new coach Mr. McAlister, senior wrangler of the previous year, Miss Marks describes to Madame Bodichon at the beginning of the Lent term, as "tall, shaggy, and, as Miss Scott says, more like a Newfoundland dog than anything else: above all, he is quite self-possessed, a rare and precious gift in a Girton coach!" In her next letter, she says he "teaches splendidly," and goes on to say:

"Work doesn't seem work, but rather some delightful form of amusement. I can't tell you how happy I am this term. All my imaginings of what it was going to be like to have nothing but mathematics to work at were small compared with the real thing. I do a little other work besides—my half-hour of Odyssey after dinner; and every day except Thursdays and Sundays I work at my embroidery for the two hours immediately after lunch."

In order to add to her income and to draw as little as possible upon the generosity of her friends, Hertha continued to take commissions for embroidery during this year; but it was naturally a great tax upon her strength, and when William Morris decided that the curtains she had spent several months in embroidering did not equal his expectations, owing to some defect of colouring that he admitted was his responsibility, she determined on the advice of Miss Orme to undertake no more needlework while she was at Girton. "I shall take a better degree for not having it to do,"

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she writes to Madame; and in this decision Madame entirely concurs, replying on one of the post-cards which, after her illness, became her usual medium of correspondence: "My dear—I never understood the principle of Morris's work; I have no opinion; but I think it is well for you to work at Girton, and for the rest, do all you can for me in your holidays, as we said." This is an allusion to Hertha's determination to give service, whenever possible, in return for the financial help she received, unless that help could be treated as a loan to be repaid; and Madame always respected her scruples. When, for instance, small-pox broke out at Girton a fortnight before the Long Vacation, and Miss Marks with two other students went into quarantine at Eastbourne, Madame Bodichon sent her £5 towards this extra expense, suggesting that half of it should be a gift, while the other half could be repaid by the work Hertha was going to do for her in the summer vacation. To which Hertha replied: "If you don't mind, I should like to treat it *all* as part prepayment of my summer work."

With reference, too, to her financial position, it is interesting to gather from a letter of Miss Orme's to Madame Bodichon (June 17, 1878), that those who guaranteed part of the Girton expenses as a loan, and not as a gift, never doubted her capacity to pay them back. "If her health is good," writes Miss Orme, "I think there is little doubt of her being able to earn a comfortable salary when she has her certificates, and I hope she will be able to meet her expenses meanwhile by adding to the loan which she is to repay in 1886." Picturing the effort and the perpetual strain implied in the obligations thus undertaken (she was still paying off her Girton loan after her marriage, I am told), one feels amazed that a student so heavily handicapped

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should still consider, as she shows in her letters, that her college years were the happiest she had known.

These letters continue, throughout her University career, to throw interesting sidelights on the early history of Girton. In one case, Miss Marks tells of the opposition offered by a section of the students, and speedily quashed by the Senior Student for the year (Miss Herschel), to the formation of a drill class, on the ground that it was "most indelicate to be drilled by a man." Hertha's remark, on another occasion, that little conversation was to be heard at college except on two subjects—"first, the party, and secondly, the war"—reminds us that while Girton students, even in their diversions, struggled for expression in England, Russia and Turkey fought for supremacy in the Near East. The party in question, by the way, was given by the Mistress, and Cambridge undergraduates as well as dons were invited to it. Hertha's description of it contains an unusual reference to her personal appearance, in connection with a lace cap she made for the occasion:

"Whether it was the cap or not I don't know, but I had more partners than I knew what to do with, and might have been engaged at least twice for every dance, sometimes three or four times. As such a thing never happened to me before, it must have been the cap. . . . When I came into the dining-hall it struck me that we were a much better-looking set than I thought, and that certainly our countenances were not 'distorted by conceit,' as a Clare undergraduate said of us at a debate! . . . Every one was very much surprised at the students' rooms being thrown open to the public. In Cambridge, it appears, Girton is supposed to be a most mysterious place, in which there is much more than meets the eye."

A reminder of her unusual social success occurs in a letter, two months later: "This week I had an invitation to go to an undergraduate's rooms to tea, which of course I refused. It was rather amusing to

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get it, because I saw him for the first time at the party, and have only met him twice since." Mathematics remained, however, her chief absorption, as she proves by constant allusions in her letters. "Miss Scott, Miss Ker, Miss Sheldon (who coaches with me) and I are going to form ourselves into a mathematical club," she writes to Madame on February 18, 1878, "to discuss any mathematical questions that may arise, and find problems for the solution of the club." Many references to articles then appearing in *Nature*, on the invention of the phonograph and the microphone, and other scientific achievements of the period, indicate, too, that she was already interested in applied science.

The year 1878 saw the formation of her friendship with Miss Margaret Ker, younger sister of Dr. Alice Ker and Hertha's Girton senior by two years. No two friends could have been more dissimilar, the young Scotswoman being a devout Presbyterian; and their intimacy is a proof of liberality of mind on both sides. Perhaps this friendship helped to modify Hertha's opinion of the religious set, of whom she wrote again to Madame (March 11, 1878) as follows:

"The longer I am here, the better I like the religious set, and the more worthy of respect I think them. They are so earnest and sincere (of course I mean the best among them) that one cannot help contrasting them with the other cynical, self-conscious set. Yet their religion seems to me a kind of accident, and it is their natures that one really admires. Of course, you cannot really separate them and their religion, but you can see that, had they been born of other parents and brought up with another set of thoughts, they would always have possessed the same earnestness, uprightness and moral rectitude. Take them all in all, Girton students are a glorious set of beings and one does not often see their like!"

The conventionality of her new friend seems to have had a further effect in an attempt to tame the rebellious

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hair that was still a sore point with Madame Bodichon; for we find Miss Ker writing in June, 1878: "I am glad to hear of the change of coiffure; I'm sure it will be an improvement." But nobody, then or later, seems to have been able to modify Miss Marks's insatiable taste for reading fiction. "I hope you are supplied with a good stock of novels," Margaret Ker writes to her derisively during one vacation; "please don't read too trashy ones. . . . Should you have felt inclined to write to me, I wonder, if you had had the choice of a novel?" A year or two later, Professor James Darmesteter commented, though with rather more discrimination, on the same matter. "You are happy to be so fond of reading," he wrote to Miss Marks; "it must be a great pleasure to have so many people in whom you feel interested and whose life you can live again for your *propre compte*."

Miss Sheldon was another member of the religious set, and her friendship with Hertha Marks grew out of their association in work, for they had all the differences of temperament that are usually supposed to keep people apart. Their separate methods of working were described to me by Miss Sheldon as resembling those of the hare and the tortoise. "While I did two pages of book work and perhaps one problem in a morning," she explained, "Miss Marks would do probably twice as much. But afterwards, she would rush off to square the circle, or something of that sort, while I plodded on, so that by the time we met our coach I had done as much solid work as she had, and sometimes more." Their recreations differed as widely as their manner of working, Miss Sheldon being very good at games but having no taste for music. Hertha's abstention from cricket and tennis may have arisen from want of means, for she was certainly athletic by

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nature, and her skill with her fingers was seen in her proficiency in knuckle-bones, for which there was a rage at Girton for a term or two. There may, therefore, have been a suspicion of sour grapes in her malicious description, for Madame's benefit, of Girton's early attempts at cricket:

"You have no idea how funny they look; they run shockingly, with their heads a mile in front of them—all except one or two. I suppose they will improve in time, but at present they send me into fits of laughter."

If she was debarred from sharing in the college athletics, Miss Marks left many memories behind her of participation in concerts and dramatic entertainments. She was always prominent in the Choral Society, sang at many of its concerts—more than one of her contemporaries remember her beautiful rendering of "In questa Tomba"—and before she left Cambridge proudly became its leader. Of the part she took in some college charades she writes to Madame:

"I sang 'Drink to me only with thine eyes,' in a deep bass voice and with a French accent. That took immensely, as did the whole of the scene, which was a 'wine' at an undergraduate's rooms; and we had long clay pipes in which we smoked brown paper. The get-ups were ulsters and various masculine-looking hats, such as billycocks; and Miss Armstead had a trencher given her, which created a great sensation. She made a most elegant young man, but all the rest looked very scampish!"

It was in connection with the Girton Fire Brigade, however, that the name of Hertha Marks was most closely associated on the lighter side of college life. Standing at a window, one day, with another student, Miss Jackson, when some ricks were burning in a field, she observed that the same thing might happen at any time to the college before help could be summoned from Cambridge. The two enterprising students then

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went up to London to interview Captain Shaw, the famous chief of the London Fire Brigade immortalized in "Patience"; and although he seemed at first inclined to smile at the idea of an amateur fire brigade composed entirely of girl students, they forced him to take them seriously. He pointed across the yard to a building where his men were practising life-saving out of top-floor windows, and asked them if ladies could swarm up ladders like that. "Certainly," was the reply, and their subsequent performance in gymnastic costume proved to him that they could. Hertha's agility especially impressed him; and after that, he gave them every possible assistance, both in training and in obtaining equipment. The college committee responded promptly to an appeal for help and supplied the hand engines, the students provided the ropes, and the Girton Fire Brigade was started and has flourished to the present day. Although no serious fire has ever occurred at Girton itself, the brigade has justified its existence by helping to extinguish fires in the neighbourhood. Miss Marks was always regarded as its founder, and she certainly put an immense amount of energy into it, and was one of the most efficient of the first four captains. A letter from Captain Shaw himself greatly encouraged the new brigade. "I think you will find it amusing," says Hertha, enclosing this letter to Madame; "the extreme friendliness of it quite overcame me. It is a precious document, so please return it."

In 1879, she was occupying the room at the end of the middle corridor, on the first floor, looking N.W. towards Huntingdon and affording a fine view of the sunset, which doubtless appealed to her when she chose it. It had a bow window across one corner—the only bow in the college—while a curtained recess

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formed the bedroom. "I have the most lovely room in the whole place," she wrote to Madame; and her contemporaries agree that, with very little furniture or luxuries, she managed to make her room expressive of herself and unlike anybody else's. Mrs. Roden Noel wrote affectionately to her: "I can well imagine you in that pretty room—a million times prettier now you are in it!" That year, Miss Kathleen Jex-Blake, and also Miss Sellers (who afterwards shared a flat in London with Miss Marks), came up to Girton; like most of the freshmen they were considerably younger than Hertha, who celebrated her twenty-fifth birthday in her second year—"though I don't feel a bit as if I'd lived a quarter of a century!" she writes. She mentions further in her letters, without drawing any envious comparisons, that most of the new students were now coming up straight from good secondary schools, like that of Miss Buss, and were not kept back, as she had been, by insufficient preparation.

She was very happy in her work all through 1879, a year in which there were certain University changes of importance to Girton College. Miss Marks mentions one, in a letter dated February 17, 1879, saying, in a reference to the Classical Tripos examination, the papers for which had to be done in the college itself by the Girtonians who were in for it: "They have got an old M.A. out to sit over them, as the examiners refuse to examine them unless they have one. It is splendid; it makes the exam. so much more formal." This year, too, the old college examinations, called "Junes," were superseded by the real thing. On May 6, she writes:

"We are going to have our May exams. the same as the King's and Caius men! Isn't it awful to contemplate? We shall have to do the papers of our year, and I don't think I'll be able to do one second-year paper. It's horrid, but it's a capital thing. Some

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of our students will do us credit, especially first-year students. It is much better than having our own silly little Junes. We are in a mixed state of horror and delight about it."

Mr. McCann, who had replaced Mr. McAlister as her coach, was next superseded by Mr. Glazebrook, whom she liked better than any other coach she ever had. "He really is a jewel of a lecturer," she writes on one occasion; and about this time, her news is all of mathematics. She does not find the Integral Calculus "so interesting as the Differential," and, although fairly partial to dynamics, "certainly likes pure mathematics best." She records one triumph, which incidentally bears out what those who worked with her always said, that while too impatient to plod over book work, she excelled as soon as originality was required. "Last week I was very cocky," she writes to Madame:

"I had a Dynamical example to do which I couldn't get out, and asked Mr. Glazebrook to do. He couldn't do it then, but said he would try it at home. It is always better to do them geometrically if you can, so we both said we would try to get it out geometrically. I succeeded in doing it a very nice neat little way; and when he came and asked me if I had done it, I said, 'Yes,' and he laughed and said, 'Oh, well, I haven't; I could only get it out analytically,' and showed me a long thing about three times as long as mine. He said mine was very good; he is very jolly, and seemed quite pleased that I had done it and he had not."

Her vacations during her college years were spent for the most part with her two friends, Ottilie Hancock and Madame Bodichon. Mrs. Hancock took her once to see Sarah Bernhardt: and Hertha wrote enthusiastically to Madame—"She is *wonderful*!"

"I can't write about her, but will tell you when I see you. We are going in to see her sculptures and paintings to-day. . . . Yesterday, Ottilie had a big At Home. I was introduced to Fred. Myers, and he asked Ottilie and me to lunch with him at the Albemarle to-day, and to go afterwards to see the Grosvenor. My time is filled up with engagements; I am quite a 'woman of fashion'!"

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She saw more of the Bellocs during her visits to Scalands, and either then or later secured a poem by Hilaire Belloc, "aged 7 years and 9 months," copied out in his mother's handwriting and carefully preserved among Hertha's papers. This remarkable piece of childish inspiration ran as follows:

THE WRECK OF THE *EURYDICE*

While it was snowing
And the wind was blowing
And the ship was going,
The Frigate *Eurydice.*

While prayers were being offered from the deck
On came that cruel cloud to wreck
The Frigate *Eurydice.*

While her royals and studdings were spread out wide
The ship reeled over on her side,
The Frigate *Eurydice.*

Just passing round
By Ventnor town
The ship went down,
The Frigate *Eurydice.*

Only two were brought ashore alive,
Now they are completely revived
And now they are going to dive
To the Frigate *Eurydice.*

Steam tugs were sent and they did try to save,
But full three hundred found a watery grave
In the Frigate *Eurydice.*

That Madame Bodichon's health continued to cause anxiety to her friends is evident from a letter of George Eliot's to Miss Marks (July 1, 1878), written from The Heights, Witley, near Godalming, which contains as well some stringent criticisms of autograph-hunters:

"DEAR MISS MARKS,—I am delighted to have your good news this morning, and only wish that the heat which suited the dear

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patient had not been exchanged for an autumnal mist and coolness. As to the autograph for the blind lady (!) I have from the first declined to comply with requests for autographs and I cannot, as you will perceive, make exceptions without causing offence and laying myself open to the charge of untruthfulness. Unless, as in the present case, I have special reason for replying, I leave the continually dropping fire of requests from America as well as England to die in silence. Otherwise, my mornings would be molested, and I should be encouraging the habit of thoughtless intrusion on the time of persons whose names happen to have become public. I am sure that Madame Bodichon and you will appreciate my reasons. . . . I am glad to hear of Madame Bodichon's pleasure in the prospect of seeing her sister—but above all I rejoice in the blessed nights of sleep and the morning and evening walks. The world will look happier to me when she is once more well. Pray offer my adieux and best regards to Miss Scott, and believe me always, Yours affectionately, M. E. Lewes."

Two postscripts follow:

"Tell Madame Bodichon that a very pleasant French novel is *Les Koumiassin* by Henry Gréville.

"I perhaps ought to tell you that I have been so teased by American autograph-collectors (with whom the affair is often a trade) that we got the American publishers to give public notice of my rule and its reasons. But nevertheless the cry is still 'They come.' I am sorry to say that Mr. Lewes is very poorly and I am so far unhappy." [1]

Miss Marks was never so contented, even in these very happy years, as when she was at Scalands; and she received with enthusiasm Madame Bodichon's suggestion that she should teach geometry during the vacation to a class of village men at Robertsbridge. She did this with great success, and Miss Ker comments in one of her letters on Hertha's "two most promising pupils, a ploughboy and a carpenter." Her holidays must have been very fully occupied, for Mr. Glazebrook was coaching her by correspondence at the same time; but excess of work was never accounted a hard-

[1] Mr. Lewes died in December of the same year.

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ship by her. It was only the call of her unfortunate family upon her that hampered her progress, and towards the end of 1879 another crisis in her home affairs threatened to put a serious check upon her college career.

Winnie's future was causing her considerable anxiety. It was thought at one time that she had some talent for drawing, and by the generosity of Lady Goldsmid, Hertha's contributions towards her support were sufficiently supplemented to enable her sister to become an art student at South Kensington. However, at the beginning of the October term, 1879, the doctor's report of Winnie's health was so bad that, hearing she ought not to live alone and must never be allowed to go out by herself, Miss Marks saw no alternative but to give up her third year at Girton, try to take her Tripos at once (in January, 1880), and return to the old life of teaching in London, living in one room with Winnie and spending all her spare time in looking after her. Her coach was much disappointed, though he predicted that, even if she took her Tripos in the following January, she might get a Third. Her intimate friends were outraged at the idea of her making this sacrifice. "I feel almost horror-struck," Mrs. Hancock wrote to her:

"to see the way in which circumstances seem to be closing about you. . . . I cannot do otherwise than think you *quite wrong*, if you allow anything to interfere with your free course at Girton. I am looking at this, not only from the point of view of friendship, but from the practical businesslike one of investment, which demands that where so much money has been sunk, a favourable result has a right to be expected. . . . This I do implore you: do not let Winnie interfere at the most critical part of your life."

Her friends not only argued and protested; they also arranged to advance a further sum, the greater part of which was a loan; though it included a sub-

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stantial gift from Ottilie, proffered in such a way that even the extreme pride of the recipient could not be hurt by it. "It will in after-years give me the greatest pleasure," wrote Mrs. Hancock to her, "to think that I have helped you to become one of those cultured women of whom the future will boast as having carried on progress. My own life is rich in joys; let me add another and help you."

It is satisfactory to know that Mrs. Hancock's generosity, affection, and foresight were alike justified in the event; and this is a reflection that may well have occurred to Mrs. Hancock herself when, in 1925, two years after her friend's death, she founded a Science Fellowship (to the value of £3,000) at Girton College, in memory of Hertha Ayrton, and so carried on the work that she began when she helped a struggling student to finish her college career in 1879. For, although the effort involved the shouldering of some fresh financial burdens, Miss Marks remained at Girton for her third year, successive homes being found for Winnie at Hastings, at Robertsbridge and elsewhere. George Eliot was among those who continued to watch Hertha's career and to sympathize with all her difficulties. In the course of a letter to her, written from The Priory on December 16, 1879, Mrs. Lewes says:

"The prosperity of Girton is very satisfactory. . . . But just now, I should be more immediately gratified by learning something of your particular prospects, Madame Bodichon having told me of your sister's sad want of health and your consequent resolve to quit Girton."

And when there was some idea of setting up Winnie in a kindergarten at Portsea, where she could live with her mother, George Eliot showed herself full of interest in the scheme (which came to nothing for various reasons), and wrote to ask Hertha to come and see her

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about it. The call was paid, and Hertha writes soon afterwards to Madame Bodichon, from 11, Union Street, Portsea:

"I went to see Mrs. Lewes on Friday, before coming down here, and she asked me all about my plans for Winnie, and if I had enough money. I told her that you and Ottilie had promised to lend me money, and that it would be quite sufficient if I did not risk any of it in a kindergarten for her, but not otherwise. She said she thought it would be very good if we could get one, and that she should strongly advise us to try, and that if I found I had not enough money, I was to apply to her. Isn't she generous? I wish I were much cleverer, and more likely to do the friends who are so good to me more credit!"

When, in the following spring, the announcement of George Eliot's marriage to Mr. Cross appeared in *The Times*, Hertha Marks, in common with most of those who had been intimately acquainted with the happiness of George Eliot in her alliance with Mr. Lewes, was thunderstruck,[1] though she wrote temperately enough to Madame Bodichon, merely observing: "I won't write what I think about it because you might not like it, especially as there may be reasons behind it that you may know, to give it a different appearance."

George Eliot must have continued, after her marriage, to take an interest in Miss Marks, for Madame Bodichon wrote to the latter in November, 1880, to say: "Mrs. Cross asks for you and your sister; do write to her from Girton; she has been ill." The end was, indeed, not far off; and Hertha was staying at Scalands and was fortunately able to be of some support to Madame Bodichon, when the news of her old friend's death reached her there in December. The following passage

[1] One of Miss Marks's intimates, discussing the sensational event in a letter to her, wrote: "Every one is talking about George Eliot. I hear Herbert Spencer is enraged, and he contemplated proposing himself!"

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is taken from a description of George Eliot's funeral at Highgate, contained in a letter from Mrs. Hancock to Hertha:

"It was a pouring wet day, and the church was almost a swamp from the rain and red mud. The service was Unitarian, and the church was crowded; large crowds stood outside as well, and many carriages. . . . In the crowd were people of all classes—many working people. One artisan next to me was sobbing, also an old woman. There were quite as many women present as men."

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CHAPTER VII

WORKING AND PLAYING (1880–83)

Miss Marks's third year at Girton, in spite of the usual family worries and her own apprehensions about the coming Tripos, was a very satisfactory one. She missed her most intimate companion, Miss Ker, who, having been placed equal to the Third Class in the Mathematical Tripos, went down in January, 1880; but in the course of the year she strengthened her friendship with Miss K. Jex-Blake, Miss Sheldon, Miss Sellers, and Miss Meyer, and she appears to have been very popular with several others as well. On her twenty-sixth birthday she writes humorously of the waste-paper basket full of flowers that four of the students had gathered for her and sent into her room by the maid who called her in the morning. Jests in mockery of her Republican opinions were frequently perpetrated at her expense, as on the occasion when her room was papered in her absence with hideous oleographs of the Royal Family. It was not only at college, however, that her advanced opinions sometimes startled her friends; for she wrote to Madame, after lunching one day in town with Lady Goldsmid: "She was very shocked to hear I was a Socialist, and we had a long conversation about social matters." The Bradlaugh controversy, which was raging just then, naturally interested her as a free-thinker; and her sympathy with his cause took her once to hear him

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speak, after his expulsion from the House of Commons.

Her opinions, as a matter of fact, never did affect her relations with the people who were interested in her as a student. Their increasing kindness to her, as the time of the Tripos drew near, made her write more than once to Madame of her fears lest she should disappoint them all. "I think I must have been born with a silver spoon in my mouth," she says in reference to some special mark of interest shown by one of these friends on her behalf:—

"When I remember all that my friends have done for me, and you most of all, I long to do some big thing to show them how grateful I am. When I leave here, I will set aside one day every week to teaching people for nothing and doing what I can to help them. In that way I may hand on a little bit of the good I receive."

A letter from Madame Bodichon (April 30, 1880) which criticizes very adversely a married acquaintance of Hertha's (since dead), whom the latter had invited to Robertsbridge during the Easter vacation, is very revealing of the sincerity of her relations with Madame. "I do not like her, and think worse of you for liking her," writes Madame Bodichon:—

"It is bad moral taste about which there is no disputing, and it is only because I am 53 and you 26, and you ask me to say what I think, that I write. You like people too much because they like you. My dear, I love you very much, and I will ask people you like even when I think they are not ladies; but a woman like Mrs. —— I will never ask to see me again, so you must not ask me to do so. I do think you are very young for 26, and you have a great deal to learn, and I fear no one can help you much."

Hertha's reply was equally characteristic. After defending her new acquaintance with considerable vigour, she adds:

"I am *very* sorry you think the worse of me for liking her, but I don't think you should. . . . I am not defending her to you; I think that is useless. If her future life doesn't do it, I am wrong,

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and if it does, my words are unnecessary. I am defending myself, and I *must* do that, because I can't bear to lose your good opinion. I know you won't mind my writing like this because you are always so very good to me, even in the smallest things; and besides, you always recognize my right to have my own opinions about things and people."

The concluding sentence of this letter is no less typical of the writer in its sudden divergence to a totally different subject: "I want to read about St. Paul when I come down, and then we can talk about him."

When Miss Scott was placed equal to eighth wrangler in the Tripos of 1880, Miss Marks described the feeling in Cambridge to Madame, who was naturally deeply thrilled by the success of Girton's first wrangler.

"When the list was read in Cambridge this morning and the man came to 'eighth,' before he could say the name all the undergraduates called out 'Scott of Girton,' shouting her name over and over again with tremendous cheers and waving of hats. . . . She bore it very composedly, blushed and smiled a little, and was invited to meet the man she was bracketed with (or would have been if she had been a man) at breakfast afterwards. He said to her: 'They made so much noise over your name that I couldn't hear my own at all'—quite good-humouredly, of course. . . . One of her papers—algebra and trigonometry—was better than any of the men's, and at the end of the three days' subjects she was third on the list; she lost the five places afterwards by not having read enough—the result of having read so very little when she came up."

Hertha describes further Miss Scott's reception at Girton, where she was led by cheering students to the great Hall and crowned with laurels, while an ode composed for the occasion by Miss Welsh was recited to her by Miss Herschel, who was now lecturer at Girton. Of the scene at the Senate House on degree day, Miss Marks writes later:

"The undergraduates gave three hearty cheers for 'Miss Scott of Girton, eighth wrangler'; and when the eighth man went up to

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take his degree, they called out: 'Where's the other? Fetch her, offer her your arm!' . . . She has completely won over one of the examiners (who had wished to refuse to examine the women) by her success; and he said, if she would stay in Cambridge, she should have his sister to coach at once. Besides this, he wanted to petition the Senate to grant women degrees; but others thought that might be injudicious just yet."

Nothing is easier than to be wise after the event, but it is difficult to avoid seeing in this hesitancy which, together with exceptional courage, sometimes characterized the early feminists, one possible reason for the long period that elapsed before the granting of degrees to women, a reform for which the undergraduates seemed almost ready in 1880. The delay, whatever its cause, allowed a bitterness to creep into the controversy which seems to have been at first non-existent, or at least latent. When Hertha Marks went up for her Tripos the question of women's degrees was more or less still in the derisive stage, expressed in the parody which appeared in *Punch*, entitled "Come into the Tripos, Maud."

The loss of Mr. Glazebrook as a coach, when he left Cambridge to become assistant to Lord Rayleigh, considerably affected Miss Marks's progress in her last year. She found her new coach far less inspiring, and, on Miss Bernard's advice, gratefully accepted Mr. Glazebrook's generous offer to coach her again by correspondence during the Long Vacation. In the October term, she concentrated on her mathematical work to the exclusion of all other claims on her attention—except, of course, those that were made by her family at home. Her only recreation was the college Choral Society, of which she was leader; and the concert that she conducted at the end of term was said to be a particularly successful one. That her college career was nearly all work and no play can be gathered from

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a remark made in one of her letters, that she went on the river for the first time in the autumn of 1880, just before she went down for good.

Until the Graces of 1881 formally opened to women the Cambridge University examinations in Honours and in Music, Girton students had to sit for examination unofficially in a lecture room of their own college, the papers being sent out to Girton in a sealed packet; as soon as the results were known, they were communicated privately to the Mistress, the names of the successful women candidates not being printed in the lists. Hertha Marks was therefore among the last batch of students who went up for their Tripos under these abnormal conditions, conditions which had a lasting and disabling effect in that the women who were examined in this unofficial way were not eligible to apply for a degree when the sex disqualification, as regards titular degrees, was at last abolished in 1921.[1]

Miss Marks may have been born, as she declared, "with a silver spoon in her mouth"; but her luck certainly deserted her on the occasion of her Tripos examination. It took place in unusually severe winter weather, and a blizzard raged outside that blew off the Hall chimney and caused the snow to lie in deep drifts all round the building. She always felt the cold acutely and was numbed by it, so it is not surprising to find her writing to Margaret Ker that her brain felt frozen all the time, and that she was much

[1] A Grace was passed by the Senate of Cambridge University in October, 1921, empowering the University to grant titles of degrees to women; and this became operative in 1923. The terms of the Grace did not include admission to membership of the University, thus leaving women graduates still short of equality with men graduates.

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troubled by her old complaint of sleeplessness. But she would have been the first to admit that her comparatively low position in the lists, of which she was conscious by the time both parts of the examination were over, was due to no outside circumstance. She had none of the qualifications that make for success in examinations, neither the nerve nor the gift for disposing judiciously of the time allowed for each paper. One of her examiners told her afterwards that she had done one part of one paper better than the senior wrangler, but she had spent far too much time over it and left too little for the rest of the paper. In addition there was, in her case as in Miss Scott's—and more so in her case than in Miss Scott's—the drawback of a defective education. As the writer of Mrs. Ayrton's obituary notice in the *Girton Review* puts it: "Like other students of that time, owing to inadequate preparation, she took a class far below her real merit." Anyone who learns from her letters the kind of work she was doing after she went up to Girton can realize how unprepared she was in comparison with any first-year student of to-day. But besides and above all these disadvantages there was, as Miss Sheldon has suggested, her own dislike of spending time over book work, her impatient desire to push on and apply what she had learnt when she had scarcely mastered first principles, and to make fresh discoveries rather than linger over what others had established already—there was, in fact, the peculiar quality of her genius, which destroyed in her the faculty that makes for success in examinations.

So when the results were known at the end of January, she had to write to Madame Bodichon what was probably one of the saddest letters she ever composed in her life. "Dear Madame"—she wrote from Mrs.

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Hancock's house in Blandford Square, N.W., on January 29, 1881—

"I am only fifteenth in the Third Class. I am so sorry. I am afraid you will be very disappointed. Miss Sheldon is last in the Second Class. So she is fifteen above me. I must have done worse even than I thought in the exam. We have another wrangler; Miss Pailthorpe is twenty-fourth wrangler. I am so glad. She at least is a credit to the college. I think it is very hard on you, after all you have done for me, that I should do no better. It is not for want of work, however, nor even entirely want of brains, but rather want of memory, and still more of presence of mind in the exam. room. So I have turned out a failure."

To this Madame Bodichon replied with her usual brevity, and all her nobility of heart and prophetic wisdom:

"My dear, you are not a failure! Your life will not be a failure. . . . Tell me if you are well and sleep well. Write by return. Always your B."

Fortunately, it was not in Hertha's nature to remain long depressed; her buoyancy soon reasserted itself and she threw herself with energy into the busy life that now opened out before her. She accepted, as a beginning, a post as mathematical teacher in the Kensington High School, under Miss Hitchcock, and undertook in addition to coach a special pupil on Saturday mornings. She detested class work, because it gave her no scope for individual teaching; and Miss Sheldon, who took her Kensington class after she gave it up, found it at sixes and sevens because, as she expressed it, "Miss Marks could never bring herself to keep Mary back when Jane was slow." This does not mean that she lacked patience in dealing with the single pupil who was backward or slow, for this was far from being the case; but it is clear that her talent for understanding and teaching the individual child was wasted in a school, and although she took another post in a

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Wimbledon school and got on much better there than in Kensington, she still wrote to Madame: "I do not like class teaching, and if only I get enough private coaching I shall be glad not to have this to do." It was not long before her wish was realized; for she wrote again, not many months later, to say that she had more offers of private pupils than she could possibly accept.

With the help of friends whose belief in her was happily unaffected by her position in the Tripos lists, she was fortunate enough to obtain as pupils the children of many clever and well-known parents. Among them were Harry Deverell, Annie Thackeray, Rosie Shore-Smith (afterwards Mrs. Vaughan Nash), Louisa Garrett Anderson (afterwards the distinguished surgeon who, with the late Dr. Flora Murray, was responsible for running the only British military hospital staffed entirely by women, during the war); as well as Frances Noel and Mary Belloc, whom she had already taught a little. Of Rosie Shore-Smith she writes that: "She is thinking of taking the first B.A. next July year and reading the maths. with me for it; I gave her her first lesson last Friday¦; she is very quick." Madame Belloc seems to have wished her to coach Mary in Latin: "But this I steadily declined to do, as it is no use my pretending to teach a thing I know so little of; so it was agreed I should give her arithmetic instead."

She did not teach the little daughter of Dr. Elizabeth Garrett Anderson for long, but long enough to be able to write warmly about her to Madame:

"Louie Anderson is a delightful pupil; figures seem to be live things to her, she has the queerest fancies about them. Everything is so vivid to her, it is a pleasure to teach her."

Miss Emily Davies helped her further to obtain pupils who wished to be prepared for the Cambridge local

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examinations; and she took an occasional adult pupil, usually in mathematics, and once at least in Hebrew. At the outset of her post-Girton career, she was ready to accept almost any work that would enable her to meet expenses and pay off some of her loans; and we find her writing an article on Girton for a magazine, copying an essay for Mr. Roden Noel, and collaborating with Miss Margaret Ker, then teaching at Croydon High School, in setting and correcting a mathematical paper for a scholarship examination at Eton: "But this is not to be talked about, as I suppose the man who gave it to Margaret to do does not want it known that a woman is examining at Eton!" She soon, however, became sufficiently independent of economic compulsion to be able to drop work she disliked, such as the Wimbledon school post and the Hebrew lessons; indeed, she very rapidly made her name as a successful coach and found herself in a position to choose her pupils. On November 5, 1881, she writes light-heartedly to Madame:

"Pupils keep pouring in. I got some new ones for arithmetic yesterday, and I take the Hampstead ones for eight hours a week. . . . My income at present, counting that I teach forty weeks in the year, is £250! It will be £270 when the new pupils begin; and there is still another to come, recommended by Mrs. Anderson. I will pay you back some of what I owe at Xmas, when I shall get at least £40, to say nothing of untold sums at Easter! Dear Madame, I *am* so glad I am succeeding at last. You have had such a lot of trouble with me, and now I am going to get on, and be off your hands at last!"

At this time she was living with Miss Sheldon in rooms at 55, Cambridge Street, Hyde Park, an arrangement that worked very well, both of them being fully occupied by day and sufficiently congenial companions to get on quite happily when their leisure hours threw them together. They saw comparatively little of each other,

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however, for Miss Marks's evenings soon became filled with various diversions. Evidently she followed Madame Bodichon's advice, conveyed by a remark in one of her letters, that "to be dull is wicked!" As early as May, 1881, the following occurs in a letter to Madame:

"I went to Mrs. Peter Taylor's party last Wednesday, and met Mr. Charles Lewes there; he asked after you, so did almost every one I spoke to. Ottilie's party is next Wednesday, and her second one on June 8, and I have an invitation to go to a very swell one with her on June 14, so you see I am getting very gay!"

At Mrs. Hancock's house, about this time, she met the Irish M.P., Dr. John Dillon, and writes of him with great admiration:

"I liked him immensely. He is very handsome, tall and very slender, with a small head and a beautifully refined face—very dark, and with such eyes! 'I felt somehow that they made me feel nohow,' as Bob Jakin says of Maggie Tulliver's eyes. He evidently hates the English with a bitter hatred, and I don't wonder. He is very well read, thoughtful, and speaks well; he looks a most melancholy man. To-morrow I am to go and dine at some restaurant with the Hancocks and Mr. Dillon, and go on to the theatre."

A year later, in November, 1882, she again meets Mr. Dillon at the Hancocks':

"Of course he ought to be looking very ill now, having retired on the score of ill-health; but I believe that was only a pretext, and the real reason was that his position was untenable on account of his opinions, which must have differed widely from those of his colleagues, to judge by his conversation. . . . He said that the great harm of the enforced struggle with England was that the national party were bound to suppress any desire to reform Ireland itself and to use all their strength against England. On the subject of Land Nationalization, Mr. Dillon said he saw no possible answer to the demand for it, but acquiescence. . . . We talked of the freedom of women, a point on which he said he had not made up his mind. He would like them to have every legal and social freedom, but was not sure he would like them to use these! He greatly fears the effect, both on men and women, of mixed medical classes.

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He is a doctor by profession, so has some right to judge. He says he fears that if there were large numbers of men and women studying together in this way, the first result would be pure Bohemianism, by which I believe he meant indiscriminate intercourse between the sexes. What would come afterwards he cannot be sure—either absolute anarchy or a much finer and nobler relation between the two sexes than there is at present. Ottilie and I of course maintained that the latter would be the case."

All Madame Bodichon's friends were naturally kind to Hertha for their friend's sake; but it is evident that they were kind to her also for her own, and among the houses that she visited pretty constantly at this time were those of Miss Greatorex, of the Winkworths, the Cobdens, and others in the same set, besides that of her older friends Mr. and Mrs. Magnus (afterwards Sir Philip and Lady Magnus), the latter of whom had known her as a child in Portsea. She was intimate especially with Maggie and Annie Cobden, the latter of whom married Mr. Sanderson and later became one of the first militant suffragists. Miss Marks, in one of her letters, expressed the warmest admiration of Mr. Cobden Sanderson for giving up his career as a barrister, in order to become a bookbinder "and live like a working man"; and she defended his course of action so hotly in a discussion with an unappreciative acquaintance, who was inclined to mock at him and at working men generally, that she afterwards declared to Madame Bodichon: "I *hate* discussion; I wish it were never necessary; but unfortunately, for anyone holding my opinions, it is almost as difficult to avoid as breathing!"

In a letter written in October, 1882, describing a party at Mrs. Magnus's, Miss Marks mentions her future husband for the first time:

"I had a great deal of conversation with a Professor Ayrton, an electrician. He is going to send me a ticket for the Mathematical Society, next time a paper on modern geometry is read."

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Besides all these friends there were also the parents of her pupils, who seem to have invited her out a good deal. Writing on this point to Madame Bodichon, she says:

"Lady Goldsmid,[1] with whom I had been lunching, gave me some amusing wordly-wise advice yesterday. She said I must meet warmly any social advances my pupils made to me. I told her it was the advice you had given me; and she replied she was sure you would want me to do the very best for myself, you were so unselfish and wise. . . . I like her because she seems to understand exactly *how* you are good to me, not in the superficial outside way in which most people see it when they call you my benefactress and me your protégée, as if that were all! She said of you: 'She is a kind of universal friend to you,' meaning that you were a friend in every sense of the word—and so you are!"

Miss Marks had not forgotten her vow to set aside part of her time for the purpose of discharging indirectly, in service to others, some of the debt of kindness that she owed on her own account; and she began now to give a weekly singing-class to laundry girls in a home run by Miss Scott at Fulham. She followed this up by opening a club herself in Bell Street, Edgware Road, for the poorest and roughest kind of working girls, though she found difficulty in carrying out all she wished to do in this club, being "appalled by the discovery that I must often inevitably appeal to empty stomachs." Her democratic views were much strengthened by her experiences among these girls; and the result of an attempt to give them a real standard of values made her write to Madame: "I have come to the conclusion that snobbishness is only a bad choice of your superiors!"

She was reading many books at this time, and not only works of fiction, for she writes almost in the same sentence of her admiration for Henry James's *Portrait*

[1] An original member of the Girton Committee.

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of a Lady and for Henry George's *Progress and Poverty*. The latter she seems to have recommended to Mr. Roden Noel, for he writes to her in November, 1883, on this and other subjects:

"I am strongly interested in all these questions, and am reading George. I am not clear about it yet. . . . What comes immediately before me here, as manager of our Board School, is the feeding of hungry children in winter; and they call me a Socialist for wanting to do so. . . . The articles in the *Fortnightly*, on the Radical Programme, seem to me exceedingly good. Something of the kind must be done, and speedily. The proper housing of the poor is a tremendous need. The mere establishment of a Republic interests me little: we must do more radical work than that; but I am not clear how far George is, or is not right. His book, however, is very interesting, and an improvement indeed on the old books about the 'dismal science.'"

Hertha paid her first visit to Paris in the Christmas holidays, 1881–2, when she stayed with her married cousin Nelly Darmesteter, at 7, Place de Vaugirard. Madame Darmesteter's brother-in-law, James, had reinforced her invitation in a letter he wrote Miss Marks in the previous autumn, expressed in the medley of French and English that always added so much to the charm of his letters. There was at the moment in Hertha's mind a project, abandoned almost immediately, of accepting a post in Australia; and M. James Darmesteter seizes the opportunity to write persuasively:

"Je ne vous voyais pas en Australie, and therefore was much pleased to hear that England will keep you. If you have a wish to see new countries, you know there is one, and a beautiful one, twelve hours' journey from Cambridge Street (fourteen hours when the sea is rough)."

To see Paris for the first time under the auspices of those two interesting men of letters, the Darmesteters, must have been a delightful adventure, apart from

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Hertha's pleasure in renewing her youthful friendship with her cousin, Madame Arsène Darmesteter; and she was easily persuaded to repeat the visit in the Easter vacation of 1883. On this occasion she fell ill, and wrote to Madame Bodichon that she was "nursed like a sister by Nelly," adding in the same letter: "I have many interesting things to tell you when we meet, about the people I have met—the Renans, Guizots, the wife of the Professor (Bellac) in *Le Monde où l'on s'ennuie*, and others." The same year, 1883, saw her again in Paris at Christmas time, on her way to join Madame Bodichon and Miss Greatorex at Genoa. Her letters to her mother and Winnie about her journey back along the Riviera with her greatest friend, are almost delirious in their expressions of enjoyment.

The joint household at 55, Cambridge Street, was given up after a year's trial, the expenses proving too heavy for Hertha to bear in addition to the payment of her debts and the maintenance of her mother and sister. Some six months later, in the autumn of 1883, she started in a fresh partnership, this time with another college friend, Miss Eugénie Sellers, who afterwards became Mrs. Arthur Strong and was for many years, until her retirement in 1925, Assistant-Director of the British School at Rome. The two set up in a flat at 13, Cornwall Residences, Regent's Park, and for a time Miss Charlotte Sellers, familiarly known as "Charlie" (now Mrs. Benjamin Leigh-Smith), came to live with them, nominally as housekeeper. But the only discoverable record of her ability for this office is a story of her having begun to stock the store-cupboard by buying a pound of cayenne pepper; and it is not an exhaustive record.

Miss Marks and Miss Sellers issued from this address a joint circular, announcing their intention of holding

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classes "to prepare ladies for the London University Matriculation, and Groups B (Classical and Modern Languages) and C (Mathematics) in the Cambridge Higher Local Examinations"; also their willingness to give private tuition at special terms. The enterprise justified itself while it lasted, and it would no doubt have lasted longer had not Hertha Marks discovered her true vocation and turned to it without hesitation, although it meant the sacrifice of the position and the regular income she had built up by three years of solid work and endeavour.

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CHAPTER VIII

A LITERARY FRIENDSHIP OF THE 'EIGHTIES

Before describing the events that led to her adoption of a scientific career, it is necessary, in order to render this account of Hertha Marks complete, to say something about her interesting friendship with Professor James Darmesteter. This was, on her side at all events, an intellectual attachment, though it is clear that some of her friends strongly suspected the existence of something warmer than friendship. This belief on their part probably owed its origin less to direct evidence of a love affair—evidence they would never have obtained, naturally, from Hertha, unless her own feelings had been engaged—than to their fears lest she should unwittingly encourage a sentiment she could not return; for she was by nature curiously unconscious of any man's interest in her unless it was a platonic interest. When Madame Bodichon, with her normal frankness of approach to a difficult subject, wrote to her—"My dear, I think you must ask James Darmesteter not to come to see you," Hertha's instant reply was that he had been giving her Hebrew lessons, during his recent visit to London—"and I don't believe he intends to make love at all; so now I feel safe in having him for a friend. He has such a splendid mind," she adds enthusiastically; "it is a delight to me to have intercourse with him."

Madame Bodichon, still unsatisfied, replied to this:

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"I do not think you are safe about J. D.," adding in a later letter: "I shall be glad if you do not go to Paris, for your friend's sake; I am sorry for him." But allowance must be made for the eternal scepticism of the older generation where friendship between a young man and woman is in question; and Hertha's French friend made it abundantly clear in the delightful series of letters, fortunately preserved by her and now in the possession of her daughter, that if he did begin by falling in love with her, he always knew from the first that his romantic feeling for her was not reciprocated, and gallantly accepted the fact in so far as acceptance involved a loyal avoidance of the subject. It is a great tribute to the fine nature of these two exceptional people that, supposing their acquaintance to have really begun in an expression of sentiment on one side or the other, it should have ripened nevertheless into one of those rare friendships that humanize and enrich the records of men and women.

From 1881, the period of the Hebrew lessons, until her marriage in 1885, James Darmesteter kept up a steady correspondence with Hertha Marks that was only interrupted when he came to London or she went to Paris. When they first met, young as he was—only thirty in 1879—he was already well known for his extraordinary knowledge of Oriental languages; and, among other literary labours, he was making his translation of the *Zend Avesta* which Max Müller considered his *opus magnum*, so new and daring was the interpretation he put upon the obscure texts of Zoroaster's sacred writings. He was then Director of l'École des Hautes-Études, and his candidature for the Persian Chair at the Collège de France was being backed by Renan, Gaston Paris and others. He did not get his Professorship until the beginning of the year 1885,

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but he writes humorously to Hertha in 1882 of an offer he had heard was to be made to him meanwhile, by way of compensation for his disappointment—something "très honorable mais peu lucratif," whereas, he adds whimsically, "I should like much better something 'peu honorable mais très lucratif'—of course, as any sensible philosopher ought to in this world of ours!"

The epoch covered by the letters, if not a great one in French history, is exceedingly varied in a political sense, including as it does the uneasy years in which Gambetta's fall was followed by so rapid a succession of ineffective attempts to form a new Ministry that the *bon mot* of the moment in Paris took the form of a greeting between friends—"Tiens! Il y a deux ou trois ministères que je ne t'ai vu!"—meaning two or three weeks. James Darmesteter's Paris was the Paris of Guizot and Bourget and the Daudets, a Paris in which Irving played *Much Ado* on his way to America, and Sarah Bernhardt produced *Macbeth* ("very fine but not at her best, and the witches the most grotesque thing I ever saw!" writes J. D.); and a very young Pachmann gave recitals, and Renan gave lectures. All the gossip of its artistic and literary and academic and political circles filters exquisitely through James Darmesteter's letters, written sometimes in English and sometimes in French, and occasionally in a droll mixture of both. As an example of the gentle raillery that appeals straight to a sense of humour but is seldom malicious, one may take this allusion to an English composer of light opera then visiting Paris:

"Do you know Miss Z——? She is very nice and gentle. I don't like very much her play, I mean I don't feel touched by it. I suppose the fault is mine, as I have not a sense delicate enough for music. She has two admirers here, a Hungarian violinist and a French barrister. The Hungarian is quite a genius (within the

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pale of his violin; as soon as he gets out of it, and even on the border, he is a conceited and rather repulsive bore; and she cannot bear it and browbeats him in the most pleasant and cruel way, though she admires him very much). The barrister is no genius, though he is very successful and clever, and he seems to have a corner in her heart; what is exactly the angle of the corner I have not measured and cannot state. (Is not this a fine specimen of *commérage* and *cancan*?)"

In similar mood, he tells a *joli mot de société*, heard at the house of a Member of Parliament where he was paying a *visite de digestion*:

"There came in Mme Floquet (the wife of that stupid Prince-expulsion-Bill fellow): she is an elderly, very stout lady, and she had entered with a young, very slender lady; she was quite out of breath and said to Mme Dietz: 'Dear me, we are so warm, we came running like two sylphs'—and then, as the 'two sylphs' seemed to call up a smile on her interlocutor's face: 'No, I mean like a sylph and a—a—a——' As the word would not come, Mme Dietz said, helpingly, with a sweet smile: 'Well, my dear, like four sylphs?'"

On another occasion he visits "the French protestant world":

"a world quite new to me. I met there the wife of the *pasteur*; she is an Englishwoman, and told me with great secrecy that George Eliot was a woman and that you have another great lady writer called Ouida, who is perhaps not so great as George Eliot, but is more brilliant!"

His admiration for George Eliot was greater than his correspondent's; indeed, it is from this correspondence that we learn of Hertha's own preference for the novels of Charlotte Brontë, a literary judgment that one can imagine she usually refrained from expressing out of personal loyalty and gratitude to George Eliot. "Did I really tell you that Jane Eyre is my *bête noire?*" he writes to her, on one occasion. "I should deserve to be hanged then!" and he proceeds to explain that, partly out of deference to Hertha's

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opinion, he has re-read Charlotte Brontë and modified the cruder opinion of his youth. "I quite conceive that you should like Brontë as a novelist better than George Eliot," he writes to her later, "though of course as a thinker and writer there is an abyss between the two." With reference to Mirah, it is interesting, too, to read this passage from the letter he wrote Miss Marks after being present at her first public lecture in February, 1885:

"Vous m'avez dit une fois que vous n'aviez fourni qu'un seul trait à George Eliot dans le portrait de Myrrha; je suis à peu près sûr que vous vous trompez; il y a une ligne et très importante que vous avez inspirée. Je ne vous le dirai pas . . . quelqu'un qui vous aura entendue Samedi saura ce que je veux dire: peut-être que vous même ne le retrouverez pas, parce qu'il y a des choses dont les autres se rendent mieux compte que la personne elle-même."

The reply to this, if ever written, is not extant; but the trait referred to is doubtless her voice, which James Darmesteter admired so much that, on the occasion of his inaugural lecture in the Collège de France, he wrote to her that he wished he could borrow it for an hour.

His genuine appreciation of the author of *Adam Bede* led, by the way, to Madame Bodichon's suggestion (prompted by Miss Marks) that he should write an article on George Eliot in the *Journal des Débats*, for which purpose she lent him many of George Eliot's letters; and he obtained others, including one written to Frau von Siebold, a copy of which he forwarded to Hertha to be passed on to George Eliot's husband, for the purpose of "discrossing Mr. Cross," because the latter was then preparing his own biography of his wife and was inclined at first to resent any anticipation of it in France.

Besides contemporary letters, the two friends seem

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to have discussed many subjects, intimate and general. It would be interesting to have Hertha's reply, unfortunately lost, to this criticism of William Morris:

"Morris is a *blagueur*, there is not the slightest doubt about it. It is very creditable to the naïveté of the British working man to have heard him without an outburst of laughter. Yet it may be of good policy to say such things to hungry people, as long as they are apt to be coaxed into stoicism. Old Guizot said: 'Le travail est un frein.'"

An echo of the modification of her own original antagonism to the religious set at Girton may be found in his broad-minded estimate of Pasteur:

"I don't know if he is a Catholic; I think not; but his sympathies are strongly for religion, and he is at any rate a decided theist. In the commonplace atheism of the day, it is a relief to find a man of genius who dares to be a believer. Our free-thinkers are such empty brains that they would make me sick of free-thinking, if free-thinking had anything to do with free-thinkers!"

They were evidently sympathetic, too, on such subjects as capital punishment; for he writes to her of having met Mr. Burnett, a great Sanscrit scholar and late Chief Justice in Madras:

"He says he had two or three fellows hanged a month; he was in Madras for twenty-three years, which makes a pretty quantity of hangman's rope: still it brought him no good luck, he has been obliged on pain of death to leave India two years before he had a right to a full pension. . . . For all his hanging he is a nice fellow; I promised to go and see him in summer. . . . At the rate of three a month, he must have hanged from 800 to 1,000 people; and he discovered hundreds of important manuscripts and inscriptions. What I like best in him is that he says Macaulay is a charlatan: I always thought so, but he is the first Englishman I heard avow it."

The intimate touch sometimes creeps in:

"What are differential equations? My fair dreams of doing Math. this year are *tombés dans l'eau*. I hope they know how to swim. . . . I wish you were here to study with me German, math. and botany and social questions and Mrs. Carlyle and

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women's rights, and to give some explanation about your last letter but one on that subject, and what not."

Stimulating and original as are his delightful accounts of contemporary affairs, the main interest for us in these letters lies in the picture they afford us of the woman to whom they are written. Nothing she ever said or wrote about herself—she is remarkably sparing of personal revelations in her correspondence—was nearly so illuminating as the knowledge we are privileged to derive from James Darmesteter's view of her mind and character, springing in him from that combination of insight with loyal and unselfish affection that constitutes the perfect friend—and perhaps the perfect critic.

We learn, for instance, of those attacks of pessimism that she was generally careful to conceal from observation. Once, when she had confided to him her involuntary feelings on being nearly run over in London, he writes:

"You must not entertain such ideas; you have not the least cause for it, having so many friends, being loved by so many, and having in yourself everything that can make life desirable and enjoyable. You can be happy, you were born with everything needed for it. . . . C'est le hasard qui commence le malheur, et c'est le caractère qui l'achève. Promettez-moi, je vous prie, que vous serez sage et que votre philosophie n'ira pas de ce côté-là. Do!"

Apparently her depression continued, for he writes in his next letter:

"You must not think so wildly, even though it would be only a passing shadow. The possibility of some unexpected calamity falling upon one is one of the conditions of life and must not mar actual happiness. . . . You are too sensitive and look forward too far."

He gives us a further glimpse of this melancholy of hers, so rarely suspected by others:

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"Do you remember our wild talk, one evening in Cécile's studio, about your idea of God's despair when he perceived that his work was a perfect failure and his creation a most uninteresting thing, and how he was driven to pessimism and threw away all interest in life, poor lonely devil of a God?"

A different side of her is revealed in one of his later letters:

"You once told me your motto: *Chi dura vince.* I wish I could borrow it from you, but I am too weak of character to do it, and mine is now *Fata viam invenient*:—it is more convenient for my moral laziness!"

We are sometimes given glimpses of her success:

"It is very nice and very flattering to have had such a letter from your Wimbledon pupils. Did you not feel a remorse in reading it? It was a pleasant punition for your having thought so little of yourself; you generally underrate your influence on people whom you meet, and it is fair you should have occasionally such lessons to snub your modesty."

About her working girls' club he says:

"C'est très joli l'histoire que vous me racontez à propos de vos girls, I admire how you manage to 'les manier.' I think you have a wonderful knack to manage people when you want to; women have generally, at least more frequently than men, but I believe you have it in a higher degree than most women I know. . . . The girls must have felt happier and prouder for submitting to what you taught them. It is so comfortable a feeling to know that one is 'directed' by somebody above oneself, that one is a 'Mahdi' in the true sense of the word. Some are their own Mahdi; those who are the Mahdi of somebody else are more happy. I wish you would accept me as your Mahdi!"

Like her other friends he is not blind to her faults, chiding her for telling him so little about herself in her letters—"C'est de l'égoïsme!"—for being "trop earnest"—"Vous dites que vous n'avez pas de cœur, vous en avez trop"—and for an "unforgiving temper." And like all who knew her, he sometimes lamented her want of leisure and freedom of mind:

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"You do yourself injustice by thinking you have not the power of expressing your thoughts in language. Your conversation and your letters are a proof to the contrary. What you want is only time and freedom. . . . As things stand now, you cannot say you have ever had a fair trial: your longer holidays have hardly been anything more than a truce between two campaigns."

There is abundant proof in their letters of a strong intellectual affinity. He speaks in one letter of her value to him as a critic, asking her if she will be willing to look over something he means to write during his holiday:

"If I know that you will read it closely I am more likely to do it. It is no small thing I ask you, as it won't be light reading. . . . If you order me to do it, it is not sure that I shall obey, but it is more so than if I should only follow my own fluctuating impulses."

We get an interesting sidelight on her admiration for Darwin, from a letter he writes her after Darwin's death:

"I understand quite well your feeling and I don't think there is any conceit in it, as I had just the same feeling on several occasions (unless I am conceited too, which may be the case, but I should not mind very much having some faults in common with you). . . . When Ste Beuve died, though I had never known him, I felt that it was of no use for me to try any longer to work, since the only one who I thought would understand me was gone. . . . It is sad to lose in one year or two George Eliot, Longfellow, Darwin, Littré, Emerson, Carlyle, Barbier, but with the exception of G. E., they were all of them past the threescore-and-ten, and some of them might have died earlier and been none the worse for it. It is true that a man of science like Darwin never dies too late, he is not so soon exhausted as a literary man because he takes his material from without and not from within. I think a man of science who has genius must be fond of life and find pleasure in living, working and discovering, and never be tired and disgusted with himself. I don't know if there can be genius without a love of life and its pleasures."

For many reasons one would like to linger over this correspondence. It is only necessary to add, however,

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what is common knowledge, that Professor James Darmesteter married in 1889 Miss Mary Robinson, the English poet and writer (now Madame Duclaux), and that, like his brother Arsène, who left Hertha's cousin a widow in 1888, he died at an early age, passing away in 1894 in his forty-sixth year. Max Müller wrote of him in *The Times* that he was "a scholar in the best sense of the word, such as France alone seems able to produce. . . . France is rich in brilliant Oriental scholars, but Professor James Darmesteter was *facile primus inter pares.*"

Nine years earlier, on hearing of Hertha's engagement to Professor Ayrton, James Darmesteter had written her a letter such as few men write and few women receive, a model of affectionate and dignified reserve:

"CHÈRE SARAH,—Je vous remercie d'avoir songé à moi un des premiers pour me faire part de votre prochain mariage. Vous savez quels vœux sincères j'ai toujours faits pour votre bonheur, et puisque vous êtes heureuse je le suis. Je sais que l'homme que vous acceptez ne peut être que digne de vous. Vous pouvez à présent entrer dans cette vie de science que vous avez toujours rêvée, et un bel avenir est devant vous. Nul de vos amis n'en jouira plus que moi, car nul ne sait plus profondément tout ce qu'il y a en vous de noblesse de cœur et d'intelligence. Je vous remercie d'avoir pensé que le changement de votre existence ne changera rien à mes sentiments: votre amitié et votre confiance m'ont, à une époque, fait plus de bien que je ne saurais dire: je vous en serai toujours reconnaissant et serai, comme auparavant, tant que vous le permettez, votre sincère et devoué ami, JAMES."

There are other letters of a later date, notably one of thanks for a wedding present on the occasion of his marriage to Miss Robinson. But the letter just quoted seems to strike the most appropriate note on which to end this literary excursion in Hertha Marks's life.

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CHAPTER IX

TWO MOMENTOUS DECISIONS (1883–7)

The years 1883–4 were of considerable importance in the life of Hertha Marks, for it was then that she finally decided to devote herself to science. A determining factor in this new departure was her invention of a line-divider. One day in February, 1883, her cousin Ansel Leo brought her the drawing of a contrivance, consisting of a series of parallelograms, designed for the purpose of dividing a line into any number of equal parts. Hertha's constructive brain at once grasped both the possibilities and the weakness of his idea, and she set to work to correct and develop it. For a short time they tried to work together, and even took out a joint provisional patent; but their collaboration soon ceased to have any meaning, for the original conception proved to be quite unsound and had to be abandoned, and the line-divider that finally emerged was entirely Miss Marks's own invention and the result of many months of labour and thought. More than one model was made and discarded before it was patented and put on the market; and a whole year later, in February, 1884, we find her writing to Madame Bodichon:

"All day I am thinking of my patent, which I have again altered, I am ashamed to say! This time I really think it has arrived at its final stage; but *qui sait*? I have no longer any faith in final stages. I sometimes think I shall improve it off the face of the earth."

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At last the perfected model was made and patented, and a maker of instruments, Mr. Stanley of Great Turnstile, Holborn, was found to take it up; and on April 3, 1884, she writes again:

"Miss Phillpott says it will be of infinite use to artists for enlarging and diminishing. . . . I showed it also to Mr. Waterhouse and he was enchanted with it, and was quite sorry when he heard I had already disposed of it, and said I ought to have got up a company; he said it was beautiful, so simple and so perfectly effective. . . . How nobody ever thought of it before is a mystery to me!"

She signs herself about this time "Your loving and frightfully egotistical Marquis"; and it is some measure of her absorption in this, her first patent, that she gave up the pleasure of joining Madame abroad for her Easter holiday, employing the time instead in taking out her foreign patents. Both Madame Bodichon and Lady Goldsmid advanced her money for this purpose, to be repaid if the invention proved a financial success. That it at once brought the inventor's name before the public is evident from the amount of notice it received in the Press. *Nature* (January 22, 1885), indeed, showed some scientific caution in its review of the line-divider's uses, summarizing it coldly as "a very handy instrument for architects, engineers and practical drawing." But the *Academy* managed to infuse a little warmth into its account of the many advantages of the divider "to all those who have to do with the line and the rule," and even added the following touch of feminist propaganda:

"The question has often been raised whether the higher education of women in science can conduce to anything more than their own intellectual benefit, and whether they are able to contribute to its advancement by means of original work. We are glad to have to record one more instance showing that this question must be answered in the affirmative. The mechanical division of a line into any number of equal parts is a problem that has often taxed the

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ingenuity of technical men, and has only just been satisfactorily solved by a former student of Girton College."

In Paris, also, the invention had a good reception, the *Revue Scientifique* (May 14, 1885) remarking incidentally, like the *Academy*, that it was the work of a Girtonian, and concluding with the words:

"L'on a souvent prétendu que la femme n'est capable que d'assimilation et non d'invention: l'appareil que nous venons de décrire est une preuve *mathématique* du contraire."

Naturally, this unusual achievement by a woman was welcomed in feminist circles here, where every piece of evidence in support of throwing open new careers to women was at that time eagerly noted. When Miss Marks was further invited in the following February to read a paper on "The Uses of a Line-divider" before the Physical Society (reprinted in the *Philosophical Magazine*, April, 1885), Mrs. Henry Fawcett, wife of the Postmaster-General and already a prominent figure in the woman's movement, wrote to congratulate the inventor, adding: "If there is any report of the meeting to be had, I should like very much to see it: I am to write an article on women's industries, and facts about your line-divider will be very useful to me."

The immediate result of the favourable reception accorded to her invention was to make its originator consider, not for the first time, the possibility of devoting herself seriously to scientific research. She had, as a matter of fact, already neglected her professional work considerably owing to her preoccupation with the line-divider; and she wrote to Madame in October, 1884, from the Hartogs'—where she was living temporarily, the partnership with Miss Sellers having been dissolved and their flat given up—to say that she had very few pupils for the autumn term. But, in addition to her

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own difficulty in combining her opposing interests satisfactorily, she was being urged by her friends to follow up the success she had achieved. The two who always continued to believe in her, even when for the moment she appeared to fall short of their expectations, were naturally the most insistent now that she should not lose the ground she had gained. When she contemplated the acceptance of a post at Girton, because it offered opportunities for scientific research, Mrs. Hancock wrote to her:

"Personally, I would a thousand times rather you did not undertake the post, but if that is the only way in which you can get the requisite practical work for your purpose, of course you ought to go. There have been too many lives and minds shipwrecked among women, for want of the resolution to endure isolation and hard work for a time—do not add your fine powers to that saddest of human sacrifices."

Madame Bodichon as usual did the big, generous thing without hesitation, and offered sufficient financial help to enable Hertha both to remain in London and to limit the number of her pupils, thus leaving herself time and energy to spare for devoting her attention to electricity, the branch of physics she particularly wished to study. This may be said to have been the second turning-point in her life, when for the second time Madame's beneficence and her belief in the girl she loved like a daughter became the means of helping her to fulfil her destiny. It was on hearing of this further evidence of Madame's prescience and kindness that Professor James Darmesteter expressed to Hertha his own devotion to Madame Bodichon—"non pas parce que vous l'aimez, mais parce que je sais qu'elle vous aime." He rejoiced when Hertha, after some hesitation, decided to accept Madame Bodichon's offer, and he wrote to her again in his characteristic Anglo-French:

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"C'est bien beau de sa part and quite like her. . . . Il y a des personnes dont on ne doit rien accepter et d'autres dont on peut tout accepter."

Mrs. Hancock also pressed her to accept Madame's offer, on the ground that "it seems wrong, if you are capable of higher work, you should be obliged by circumstances to keep to the lower for the sake of bread and cheese." So after a short holiday at Scalands with Madame Bodichon, Hertha went up to Portsdown Road, whose hospitable door always stood open to her, and wrote thence on September 27, 1884: "Professor Ayrton called on Saturday, and I have arranged to go to the Technical College four nights a week, beginning next Monday."

Professor W. E. Ayrton, F.R.S., was then Professor of Physics at the Technical College, Finsbury, and it was under him that Miss Marks commenced her scientific studies in the autumn of 1884. That the two had already become friends is evident from the fact that the Professor took considerable interest in her wish to study electricity, and did all that was in his power to enable her to realize her ambition by arranging for her to become a special student at Finsbury, while carrying on some of her teaching work at the same time. At the outset of her new career, however, her work received a check owing to the sudden and very serious illness of Madame Bodichon, which occurred in October, 1884, during a visit to her niece, Mrs. Moore, whose husband was Warden of St. Bartholomew's Hospital. For weeks no visitors were allowed to see the invalid, even Hertha being at first excluded from the sick-room; but as soon as Madame could be moved to the house of her old friend, Dr. Thompson, at 48, Cheyne Walk, Chelsea, Miss Marks had the great delight of being allowed to accompany her there and to help in nursing

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her back to health. This was necessarily detrimental to her work, although it did not prevent her from making a success of her paper before the Physical Society in February; but no considerations of personal ambition would have stood in the way of her devoted service to Madame Bodichon. This was only one of the occasions on which, when human interests seemed to clash with others, Hertha unerringly followed the instinct which made her place persons before affairs, however important the latter might be in relation to her career.

She was now, however, on the threshold of the event which was to enable her for once to follow the call of happiness and human desire without at the same time sacrificing her ambitions. The relationship of teacher and pupil had helped to cement the friendship between Miss Marks and her Professor, which had now reached the interesting stage at which the opinion of one mattered considerably to the other—mattered so much, indeed, that Professor Ayrton even sought his pupil's criticism of the book on electricity he was seeing through the press. A letter he wrote to her from London, when she was watching over Madame Bodichon's convalescence at Hastings, shows the friendly terms now established between them; in addition, it is important for a passing reference to his views on the relations of men and women, and for a story he tells of his little daughter Edith. "My dear Miss Marks," it runs:

"How can you be so cruel as to talk about my not deigning to let you see the proofs of my book? That remark borders on the wicked, and is even wickeder than your abandonment temporarily of Finsbury. . . . Why 'ought you not to trouble me with questions'? Well, I am going to trouble you with some in the form of a first instalment of proof for your next Saturday's reading, which asks for corrections. Please make any corrections, suggestions, etc., you like, and make the publisher's hair stand on end at

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the expense the corrections will entail. Perhaps, if you get very argumentative about the proofs, I shall stroll down to Hastings to convince you that you are wrong. I know how Hastings looks at this time of year (this Wednesday morning, for example) with its cliffs and blue sea.

"Did you see an article in the *Daily News*, a leading article, about yourself?—about women inventors? The subject of the difference between men's and women's minds is one that interests me much. By-the-bye, I think that was one of the last subjects on which we spoke when we met, not in the teaching capacity. . . . My young shaver in Gloucestershire gravely propounds the following in her letter to me of this week. I quote verbatim. 'Look here, Pup, you are up in mecanics if an irresistable force met an umoveable object what would happen.'—Sincerely yours, W. E. Ayrton."

Whether his pupil grew "argumentative" or not about his proofs is not recorded. But we know that Professor Ayrton soon found it necessary to "stroll down" to Hastings and to call unexpectedly, one day, at the house on The Lawn where Madame Bodichon was staying. For, in a letter dated April 6, 1885, Hertha wrote as follows to her mother at Portsea:

"My dearest Mother,—I have something to tell you which will give you both pleasure and pain, but I hope for my sake you will let the pleasure overcome the pain. Yesterday evening, Professor Ayrton asked me to marry him, and I accepted him. You remember who he is. He is one of the first electricians of the day, and he has promised to let me do, or to do himself, the same for you and Winnie that I should have done if I had not married. He is also going to let me go on with my electrical work, and of course he can help me in it in every way. He is very good and kind and upright, besides being so clever, and besides all this and above and beyond it all, I love him. I am so happy, I hope you won't take away from my happiness by being unhappy yourself. You know how much I love you, dear Mother, and I would do anything I could to make you happy, but the one thing I could not do would be to give him up. Write me just one little word yourself. Always and for ever, Your loving daughter, Sarah."

Sarah's apprehension lest her mother should be disturbed by her news was not without foundation. Mrs.

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Marks's orthodox religion forbade her to view without consternation her daughter's marriage to one who was not of the Hebrew faith or race; and the tidings of the engagement at once reopened the wound that had been inflicted at the time of Sarah's rejection of her hereditary faith. It was a great blow to Mrs. Marks that her favourite child, the one she loved and believed in above all others, should not marry a Jew; and the stricter among her relatives shared her disappointment. Fortunately, Mrs. Marks's affection was still deeper than her religious and racial fervour; and although it is certain that her daughter would not in any case have yielded to her on this one point, many as were the sacrifices she was prepared to make for her family, it is satisfactory to be able to record that she was never called upon to do so and that her mother accepted the inevitable as she had accepted it in the former case. At the same time, while perfectly aware of the worldly advantages of her daughter's match, Mrs. Marks lived down her disappointment, not because of these advantages, but because she loved her daughter too much to stand in the way of what was obviously for her happiness.

At the time of their engagement, Will Ayrton, as he was always known among his friends and relatives, was a Fellow of the Royal Society, as well as Professor of Physics at Finsbury. He was a widower, having married, when a young man in his twenties, his cousin Matilda Chaplin, one of the pioneer women doctors; and they had one daughter, Edith, who afterwards became Mrs. Israel Zangwill. For a time after his first marriage, while his wife studied medicine both in Edinburgh and in Paris, Will Ayrton continued to fill his Government post in India; a little later, they both went to Japan, where he held a Professorship in the new

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Prof. W. E. Ayrton, F.R.S.

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University at Tokio. On their return to England, Dr. Chaplin Ayrton, having taken her degree, set up her brass plate on their house in Sloane Street, only to break down immediately in health. After fighting her delicacy for three years, during which she wintered regularly abroad, Dr. Chaplin Ayrton died, without having practised as a doctor, though in the intervals of ill-health she had pluckily done what hospital work she could.

It was Miss Chaplin's fiancé who first urged her to study medicine seriously; and that Mr. Ayrton should have given her such revolutionary counsel at that period, and on the eve of marriage, reveals an exceptional point of view about women. So it is easy to understand some of the qualities that drew Professor Ayrton and Hertha Marks together, when they met, first as acquaintances in the houses of mutual friends, and afterwards in the laboratory at Finsbury where he came in contact with her original mind. It would have been impossible for either of them to have found an affinity in a partner who did not possess special distinction of intellect as well as striking personal attractions; and these qualifications were fortunately present in both of them. Mrs. Ayrton Chaplin, a cousin by marriage of Professor Ayrton and sister-in-law of his first wife, mentions this point in some notes she gave the present writer on Miss Marks, whose intimate friend she became. "Hertha's love of beauty," she writes, "must have been much satisfied by the unusual beauty of her husband as a young man in his prime. She herself was one of the most interesting companions I have ever known, full of ideas and observation, and always interested in other people's affairs as well as her own. . . . She also enjoyed the beauty of her stepdaughter, and though she was glad of the same gift for her own daughter, she never, so far as I know, thought of comparing the two

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half-sisters in any way." I can endorse this statement myself; for, a good many years later, Mrs. Ayrton told me with great pride how charmed Professor Curie and his wife had been with the prettiness of both the Ayrton girls, whom they met at a reception given by Professor and Mrs. Ayrton in honour of their French guests: she then gave me the impression of being as proud of her stepdaughter as of her own child, and seemed to rejoice as much in the admiration excited by the one as by the other.

Another mutual acquaintance, who saw Mr. and Mrs. Ayrton a good deal about the time of their marriage, has told me of Hertha's arresting personality and interesting conversation, adding with reference to Professor Ayrton: "I always liked being taken in to dinner by him; he had such courtly manners, and you could not feel shy with him. If you were shy, he did all the talking and put you at your ease."

It is possible that some of his pupils did not find him courtly or themselves at their ease with him; for, as one of them has told me, "The trouble with the Professor was that he never realized how clever he was, and so he expected far too much from ordinary people." The same informant, who knew both Professor and Mrs. Ayrton extremely well, added that, when absorbed in an experiment or some other work, the Professor would not leave it for meals or any consideration. "His wife was the only person who could make him remember he was a human being and required food and sleep—in fact, the only person in the world to whom he ever paid any heed on those occasions. All the same," added this old pupil of his, "we all got a great deal out of him, though we were rather frightened of him!"

Professor Ayrton's belief in the right of women to

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equality of opportunity with men was as important in the husband of a woman like Hertha as it was then rare among men of science. From the first he recognized her unusual ability, and he never from that moment failed to encourage her in her scientific work. What was still more remarkable, while welcoming her co-operation if this happened to be of advantage to them both, he always insisted on her pursuing her own line of research whenever possible, and making her own experiments. He knew well enough how readily any success that she achieved would be attributed to the assistance of her husband; and that his fears were to some extent justified was shown more than once, both before and after his death. It is probable that a sense of this sex prejudice, which occasionally dogged her progress, was the impelling force that led Hertha to defend Madame Curie, whenever the opportunity occurred, from the same imputation. In 1909, for instance, when Monsieur Curie died as the result of an accident in Paris, and many English newspapers acclaimed him as the discoverer of radium, Mrs. Ayrton wrote, in a letter to the *Westminster Gazette* (March 14, 1909), "Errors are notoriously hard to kill, but an error that ascribes to a man what was actually the work of a woman has more lives than a cat"—and she proceeded to give unanswerable proofs, which the editor readily accepted and made a sympathetic comment upon, to show that radium had been discovered by Madame Curie, alone and unaided, though her husband afterwards helped her to extract it from pitch-blende. Mrs. Ayrton's timely championship of her French colleague recurs to one's mind when, as still occasionally happens, one encounters the implication that Hertha Ayrton owed her scientific reputation to the circumstance of having been the wife of Professor Ayrton.

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The news of her engagement brought Hertha more letters of congratulation than she could find time to answer, her two most intimate friends being, of course, the first to rejoice over her happiness. She was married on May 6, 1885, Mr. and Mrs. Hancock lending their house in Queen's Gate for the wedding; and she had the interesting experience during her wedding trip of accompanying her husband to the meeting of the Physical Society at Clifton, where, as the bride of one of the vice-presidents, she had the place of honour next to the President at the official luncheon, and met many of Professor Ayrton's colleagues. It was during the same summer that she laid the foundations of her friendship with Mrs. Ayrton Chaplin, then staying at Lyme Regis; and the latter remembers the disappointment expressed by Hertha at having found that the wives of scientific men were not necessarily interested in science. It was a sign, Mrs. Chaplin felt, of the very high intellectual standard of the women to whose companionship Hertha was accustomed.

Besides their mutual interest in Will Ayrton, who was regarded as a brother in the Chaplin household, the two women had a common bond of sympathy in the little stepdaughter, Edith Ayrton, who, since her mother's death, had spent most of her time at the Hermitage, Uckfield, in Gloucestershire, where the Chaplins kept a small school on rather original lines for boys and girls, most of whom were relatives and Anglo-Indian children. Here Edie had been rapturously happy, always regarding the place as her home, although she came occasionally to London for holidays. It was during the Christmas vacation of 1884 that she first met her future stepmother, at a children's party in Mrs. Hancock's house. Professor Ayrton had been amusing the children at this party by doing conjuring

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tricks, one of his most popular accomplishments; and Mrs. Zangwill recalls how, on their way home in the cab, her father talked to her for the first time about Miss Marks, especially praising her nobility and unselfishness in working so hard to support her relatives.

Hertha's love for all children led her to anticipate with confidence her future relationship with the little stepdaughter; but she did not allow for certain prejudices in Edie's mind that were very natural prejudices under the circumstances. Mrs. Chaplin gives much credit to Hertha for her generosity, which never allowed her for one instant to resent Edie's perpetual comparisons between her stepmother's household and that of the Hermitage, which the child regarded as perfect in every way. But it is probable that Hertha was at first innocently unaware of the reasons why she failed to secure Edie's confidence. She was used to making an easy conquest of every child she met, and it puzzled her greatly to find, when Edie's cousin Ulla (afterwards Dr. Ursula Chaplin) brought Edie to Scalands just before the wedding, that the attractive little girl whom she was so ready to love did not intend to be easily conquered. Fortunately, Ulla, like Mrs. Chaplin, was quick to discover what an excellent stepmother Hertha would make for the child of whom they were so fond: and friction being impossible between people who are equally generous by nature, the situation was not further complicated by want of understanding on the part of Edie's relatives.

Perhaps, if Edie had been allowed to remain at school at the Hermitage, where she was happy, some misunderstanding might have been avoided. But Professor Ayrton was naturally anxious to have his daughter to live with him; and although the change was not effected at once, as the Ayrtons had no house of their

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own at that time, owing to the Sloane Street house being let furnished, Edie may have quite reasonably, though unjustly, ascribed the blow, when it fell, to the fact of her father's second marriage, a conclusion that no doubt delayed the removal of the barrier of reserve that existed between her stepmother and herself. However, in time all barriers were swept away, and these early difficulties would not be worth mentioning if they did not serve to show the good feeling and wisdom of those concerned, which in the end created exceptionally happy relations between Mrs. Ayrton and her husband's child; and these, once established, lasted unbroken till her death. Mrs. Zangwill has spoken with especial warmth of her stepmother's generosity towards her, and of her anxiety lest the Professor's daughter should suffer financially through his second marriage. For instance, when Edie refused to accept more than half the sum of money that Hertha urged her father to give her for her trousseau, Professor Ayrton said with half-humorous alarm that the "B.G."—short for "Beautiful Genius," Mrs. Ayrton's nickname in the intimacy of the home circle—would be very angry with him!

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CHAPTER X

SCIENCE AND DOMESTICITY (1887–98)

For a year or two after her marriage, Mrs. Ayrton carried on her scientific work; and at the beginning of 1888, by which time she was established in her first house at 2, Upper Phillimore Gardens, Kensington, she gave a series of six elementary lectures on electricity, perhaps by way of an intellectual house-warming. That a woman should lecture to women on such a subject—or a lady to ladies, as it was described in those days—was regarded as a startling innovation; and the *Star* (January 18, 1888) even speaks of her as "plucky" for making the attempt. But to those who read her syllabus to-day its main interest lies rather in its practical nature and in the lecturer's enlightened anticipations of the development of domestic electricity. In the 'eighties, it must have been a revelation to the ordinary person—and her lectures were addressed to the ordinary person—to hear that in the home this still unused force might be employed to save labour by driving the sewing-machine, cleaning silver, as well as boots and knives, and winding clocks; that "seeing by electricity" and electrical sound-magnifying were not impossible miracles, and that, indeed, life might be altogether transformed in various ways that at the time of writing are still unrealized in the average home. The whole motive of her course of lectures was eminently characteristic of the lecturer, who always hastened to

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apply to general utility everything she ever learned or discovered.

But for the most part the early years of her married life were not marked by any considerable scientific research. This was principally the fault of circumstance; for it is certain that neither Mrs. Ayrton nor her husband believed that a woman's whole energies need be absorbed by her household, and the Professor had given ample proof during his first wife's lifetime of the importance he attached to women's professional work. Ill-health was the chief reason why Hertha at first found it difficult to do more than manage the home and perform the many social duties that naturally devolved upon the wife of a distinguished man of science; and she was, besides, inclined to be overscrupulous about accepting help from her husband for the family at Portsea, to say nothing of her own maintenance, unless she gave the major part of her time to meeting these domestic and social calls. In a woman of her independent spirit, accustomed as she had been for many years to support herself and her family, this delicate sense of honesty was not remarkable. But her general lack of physical strength was her primary disability, even before her bad illness in 1888–9, and before her child was born, two events that naturally contributed to her temporary inactivity outside the home.

Those were very happy years, notwithstanding; for she attended scientific gatherings and entertained many eminent persons. Writing to her mother in September 1888, she tells with delight of Professor Ayrton's paper read to the British Association at Bath, which a deputation of working men requested should be repeated at their institute—"a great honour and quite unprecedented." In another letter, dated Decem-

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ber, 1890, she describes a luncheon party at the Langham Hotel, given by her husband and herself to Professor Hertz, who had come to England to receive the Royal Society's medal:

"We had fourteen distinguished men to the lunch, and a crowded reception afterwards. There was not a dull moment; and I found it great fun being the only lady at lunch among so many well-known men. At four o'clock the 'At Home' guests began to arrive, including Sir Frederick and Lady Abel, Mrs. Fawcett, and lots of other great folks. Many of them said, as they were going, what a delightful afternoon they had spent. Some of them would hardly go at all, and had to be dragged away by their wives and daughters! . . . Yesterday I went out to dinner, and to-day I have a Girton committee, so you see I am busy."

The mention of Girton is an allusion to the fact that from 1886 to 1892 Hertha was the Certificated Students' Representative; that is to say, according to the procedure then obtaining, she was elected by all the certificated students to represent them, and then appointed by the college as a member of the College Committee.

The greatest happiness that befell her at this time was the birth of her daughter, Barbara Ayrton Bodichon, "the little professoress," as Madame Bodichon called her—afterwards the wife of the poet and writer, Gerald Gould. It is easy to imagine what the coming of a child of her own meant to the woman who, from her earliest years, had mothered every child that came her way, beginning with the younger members of her family at home. Madame Bodichon shared to the full her joy in the little daughter. "Courage!" she wrote to the mother before the baby's birth; "do not travel unless you are able; everything must be done to safeguard sacred people." And afterwards, when paralysis made it impossible for Madame to do more than scrawl a few words on a post-card, she always managed to send some message to the baby, such as the following, written

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from Scalands on a spring morning: "I want to send love to your Barbara, to say we all love her and the birds are coming on; I saw a nest with four eggs to-day."

The baby helped, too, to break down barriers; for Edie had all Mrs. Ayrton's love for mothering children, and her stepmother's letters, throughout Barbara's childhood, are full of absurd details about the child who drew them together as nothing else had done;—when, for instance, Edie went with her father to attend the Electrical Exhibition at Frankfurt, and later, to the Chicago Congress, and had to be kept posted up in all the home news. Or when she was staying with her Aunt Edith (Mrs. Chaplin), and Mrs. Ayrton wrote to tell her that Barbie had sobbed inconsolably on seeing her father sprain his ankle, and when adjured to cheer up because it was not a serious injury, had asked in surprise (remembering a recent tragedy with regard to a pet dog that was run over): "But won't he have to be shot?"

Barbara inherited her father's colouring, being as a child fair-haired as well as blue-eyed; and Miss Frances Noel, recalling a visit paid by the mother and daughter to the Roden Noels in their Surrey home, speaks of the charming contrast they made standing in the wood among the bluebells—"both so pretty and so different, the little girl with her fair complexion and golden curls, and the mother with her brilliant colouring and black hair." Mrs. Ayrton never attempted to disguise from Barbie that she was a pretty little girl; and once, when the child came to ask her if she was as ugly as a foolish maid had just told her, she at once disabused her mind of the notion—though, as she afterwards explained to some one, relating the incident—"I did not think it desirable that she should dwell upon her looks, one way or the other, only that she should not

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be told what was not true." And probably she chose incidentally the best way of preventing the child from dwelling upon her looks.

The opportunity may be taken here of mentioning the perfect relations that existed between mother and daughter from Barbara's earliest childhood. They were always friends in the very highest sense of the word; and perhaps, when one has said that, one has said all that need be said. It is a common experience of many who have theories about bringing up children that those theories break down when they have a real child to educate. This may have been partially true also of Mrs. Ayrton, who was nothing if she was not human; but if so, it was not apparent to any observer, or to Barbie herself, who did not find until she went out into the world, in her school-days as well as later in life, and saw other children with their parents, how uncommon were the confidence, the understanding and the intelligence that marked the tie between her and her mother. One small instance, among many, of the footing on which they always stood occurs to one's mind, writing this. In a letter to Professor Ayrton during one of his absences from home, Mrs. Ayrton gave the following typical account of Barbie in her budget of homely news:

"She told me the other day that she thought your tastes depended on the way you were made. 'You see, mother, Billy likes lessons and reading and all that sort of thing, and I like climbing and running and riding and swimming and gymnastics. I think it's the kind of way you're *made*.' She and I have made a bargain that if she'll read a story to herself every wet day, as well as doing her reading with me every day, that she shall no longer be twitted with her ignorance, nor have stories of other little girls brought up against her. It was her own suggestion!"

If it is true that the perfect relationship between parent and child is only reached when the parent has

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not forgotten how to be a child and the child is allowed to regard itself as grown up, then the relationship between Mrs. Ayrton and her daughter must have neared perfection.

There were of course troubles, too, in those early years; and prominent among these was the severe illness that incapacitated Mrs. Ayrton for many months, forcing her to live out of London, sometimes at the seaside in rooms, sometimes at Scalands. The baby and her nurse went with her, while Edie, a very juvenile but capable housekeeper, had the pleasure of managing the house for her father in London, where she was now attending a private school as day pupil. Mrs. Ayrton's breakdown was attributed directly to the overstrain of a walking tour taken with her husband during a summer holiday; but there is no doubt that her constitution had been already undermined by the hard work and occasional privations of her girlhood, and it must always remain a matter for regret that she was hampered all through life by a physique impaired in youth, that never proved equal to the demands made upon it by an untiring spirit.

A far greater blow fell upon her when, in June, 1891, Madame Bodichon succumbed to her last illness after some years of increasing incapacity. A few weeks before, Mrs. Ayrton wrote to Edie of Madame that "her household will not let her die"; but all the desire of those about her to keep her with them was of no avail when the final seizure came, and this very remarkable woman, a pioneer of women's higher education, a fine artist and a devoted and generous friend, passed away in the country surroundings and the summer weather that were so dear to her. "What a blessing for you to know how much she loved you!" wrote Madame Belloc to Mrs. Ayrton; and that was the note struck

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in the many letters of condolence that she received. "That you and your child were able to be so much to her may be some consolation to you in the loss of such a beloved and unfailing friend," wrote Miss Emily Davies, enclosing a copy of the resolution passed by the students of Girton in memory of the woman to whose important share in the foundation of the college they owed so much.

Another mutual friend, Princess de Gorloff, refers also in a letter written from Penshurst on June 23, 1891, to Hertha's "irreparable loss." "It will have left your life very lonely," she says; and Mrs. Ayrton was indeed described by some one else at the time as "almost heartbroken." The present writer, who did not meet Mrs. Ayrton until some years afterwards, can testify to the influence that Madame Bodichon's memory continued to exercise upon her, and of the many occasions on which she talked of the greatness of Barbara Bodichon and of the force she had been in the lives of others besides herself.

In October of the same year, Mrs. Ayrton suffered another loss in the death of Winnie, the sister she had loved very faithfully and for whom she had made many sacrifices. By the kindness of Professor Ayrton and others, Winnie had been sent on a voyage to Australia in 1886, but after her return she spent much of her time in hospital, and when the end came it found no one unprepared. Professor James Darmesteter, who always got on well with Winnie, besides, like others, befriending her for her sister's sake, wrote the most understanding letter of sympathy that Hertha received. "La vie a été pour elle un don douloureux," he wrote:

". . . et que vous aviez réussi à lui adoucir à force de dévouement. Du moins elle vous a dû, à défaut du bonheur qui était impossible,

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le repos de sa vie et les quelques éclairs de joie qui ont traversé son existence."

Madame Bodichon crowned the many acts of generosity that had marked the twenty years of her affectionate intimacy with Hertha by leaving her enough money to provide her with an independent income. The effect of this was doubtless the one anticipated by Madame Bodichon; for Mrs. Ayrton was now able, not only to relieve her husband of the task of supporting her mother, but also to engage a lady housekeeper to relieve her of much of the domestic routine to which she had felt herself bound since her marriage. It must not be thought, however, that Mrs. Ayrton was a woman who despised or in any way resented the claims of home and family life. On the contrary, they interested her greatly and gave her many opportunities of exercising various talents she possessed, such as her gift for invalid cookery, for needlework, embroidery, and making clothes, as well as a power of organization that is invaluable in a household. She cheerfully threw herself when necessary into the work of running her house, and ran it far better than many so-called domestic women, extracting from it every morsel of the pleasure that comes to people like her simply from doing a piece of work as well as it can be done. Her success in her two spheres certainly did not depend solely upon the happy accident of possessing means of her own; for it is indisputable that domestic success is not always achieved by women of means, even when they are free from the distractions of genius or of a professional career. I once heard Madame Curie, when on a visit to Mrs. Ayrton, express admiration for the way in which the latter managed to organize her household and to delegate work to others, so as to free herself for her scientific labours; and the opinion was worth

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having, for Madame Curie's problem in Paris, where she was both Professor of Physics and the mother of two young children, was not unlike her friend's problem in London.

Hertha Ayrton's work on the electric arc, which was soon to make her famous, began almost by accident. The Professor was appointed in 1893 to go to the Electrical Congress at Chicago, as one of the British representatives on the Chamber of Delegates. This necessitated his leaving uncompleted some experiments on the electric arc, on which he had been engaged at the Central Technical College, Exhibition Road, Kensington (afterwards incorporated as the City and Guilds (Engineering) College), where he now held the Professorship of Applied Physics. As he wanted to read a paper on the subject at Chicago, and Mrs. Ayrton was unable to accompany him to the States on account of the long sea voyage, she undertook to continue the experiments for him at the college, with the aid of his pupils and assistants. This she did accordingly, keeping him posted in the progress of the work in her bi-weekly letters; and the paper he subsequently read to the Congress was based on the results of her experiments as well as his own. That paper may therefore be called one of the few pieces of scientific work in which the Ayrtons really collaborated. It led to further research and experiment on the part of Mrs. Ayrton alone; for these investigations stirred her interest keenly in the whole subject of the electric arc.

"I should like to solve the whole mystery of the arc from beginning to end," she writes enthusiastically in one of the budgets she sent to Chicago; "I have lots of material for experiments that we cannot even attempt in time for you." A week or two later, she refers to this again, saying: "Hissing wants a whole series of

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experiments to itself;" and again, in a later letter: "Of course I feel that I have only touched on the fringe of the subject; it would take months of hard work to clear it up, and that is what I would be quite willing to give to it, if I can experiment at the college."

Her husband begs her frequently, in his answers to these letters, not to overtire herself. "No experiments are worth to me a day's illness on your part," he writes; but she assures him in reply that "Work suits me when I can give myself up to it;" and, in the last letter she wrote him before his return, she sketched out for herself a scheme of research on the arc, adding:

"I feel in excellent working trim now, and the next few years of my life ought to be the best."

When Professor Ayrton's paper, embodying her recent experiments, was burnt at Chicago through the carelessness of a negro servant who lighted the fire with it, she set to work at the Central Technical College (South Kensington), entirely on her own account, and partly on the lines she had been following at the time of her marriage. She wrote the following description of what she was doing to Edie, in the summer of 1894:

"You will say 'better late than never,' when you see this letter. The fact is, Dr. Lodge, when he was here, started me off on my old experiments that I did five years ago, by telling me that I ought to have published them, saying they were much more important than arc lamps at present, and so on; and as they really bear upon the arc lamps work, I have been very busy on them, and too tired when I got home in the evening to write letters. Dr. Lodge was delightful, and I think he enjoyed his visit. We had a dinner party for him, at which we had Norman Lockyer, the two Perrys, Hamo Thornyroft, Julia, Miss Courtenay, Tina's cousin, two Hopkinsons, and Mr. Larmor, an ex-Senior Wrangler. It was the night of the Electrical Engineers' soirée, so, as Miss Courtenay went at 10, all the rest of us went off there."

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At the beginning of 1895, she accepted an offer to write a series of articles on the arc for the *Electrician*. She wrote in January, 1895, to her stepdaughter, who, had been ill since her return from Chicago and was then wintering on the Riviera:

"These blessed articles for the *Electrician* will go on for months, I believe. The more I say, the more there is to say. I haven't yet come to the end of Father's experiments and the deductions from them, and then there are all my own, and writing makes you think out so many more things. I believe, when it is finished, it would make a very respectable book. . . . Ottilie came and saw me at the Central yesterday, where I was making some clearing-up experiments, and much amused the student who was helping me (I don't know his name) by saying she congratulated me on my papers. She had religiously read them through and couldn't understand a word of them! I thought it showed great devotion on her part to read them."

The papers in the *Electrician* were twelve in number and afterwards formed the basis of her book on the electric arc. They attracted considerable attention while they were appearing, not only because of the important original matter contained in them, nor even particularly because they were written by a woman, but also because of a certain freshness of approach which appeared to be the result, in the writer's case, of her not having spent so much time as the ordinary student over the groundwork of her subject. "It seems a terribly rash thing to have done, as I see it now," she confessed, some years later, to a Press interviewer; "but, you know, going into something fresh without preconceived ideas, one sometimes sees things in a light that might escape those better grounded in the subject. It is immensely more interesting," she added impulsively, "to plunge straight into a thing like this than to begin with the alphabet of it!" The last remark would have seemed to her old college friends

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extraordinarily characteristic of the Girton student who used to "rush off to square the circle" before she had properly mastered first principles.

Professor Ayrton seems to have held similar views with regard to what he called, in a letter written to Hertha Marks before marriage, the "tools" of science. "I am glad," he then wrote to her, with respect to her decision to study at Finsbury instead of Cambridge—

"you admit that the scientific success of a person depends more on the person than on the tools he uses, and from that admission you will be led to the deduction that great attention to the sharpening and improving of tools may leave little or no time, no energy, no taste or aptitude for using them."

Mrs. Ayrton's faculty for dispensing as far as possible with "tools," in the sense applied to the word by her husband, may be considered the quality of her defects or the defect of her qualities; in either case, it inspired her to explore in new directions and to reach new conclusions that could not be ignored by the scientific and engineering world. So new, indeed, were some of her experiments that fresh apparatus was required for them, which she designed and Professor Ayrton caused to be constructed for her at the Technical College. Only her inability to undertake the physical fatigue of a long voyage prevented her from accepting an invitation to read a paper on her researches before the British Association at Toronto, where the Association met in 1897; it was, however, read for her by proxy, under the title "On the relations between Arc Curves and Crater Ratios with cored positive Carbons."[1]

At the next meeting of the British Association, held in 1898 at Bristol, Professor Ayrton presided over the Mathematics and Physical Science Section, and con-

[1] See Report of the British Association for the Advance of Science (Burlington House, London, W.1), for the year 1897.

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sequently occupied the chair at the session in which his wife read another paper, this time on "The Drop of Potential at the Carbon of the Electric Arc,"[1] in which she described her attempts to find some insulation material that would stand the heat of the arc and would not be so thick as to disturb it unduly. She had tried asbestos, only to find that it melted and fell in drops like metal; and her statement, that she hoped soon to find the right material for insulating the exploring carbon and thus to solve the question of the constancy of the drop of potential at the carbons of the arc, was of much interest to the initiated among her audience.

But the *Outlook* (September 17, 1898) probably expressed the views of the less scientific visitors present at the meetings of the Association, when it hinted that Professor Ayrton had probably found it a relief to turn temporarily from "springs and coils and magnetized needles" to his paper on "The Science of Smell," in the preparation of which, it was stated, he had collaborated with Mrs. Ayrton, "herself a physicist of no mean eminence in experiment and theory alike." The little daughter, Barbara, also took part in these experiments, immensely proud of an acute sense of smell that made her of real value in what was quite a family affair. It does not appear that these joint researches were ever pursued any further on behalf of what the *Outlook* called the "Cinderella of the physiologists," though these first experiments, according to the same authority, were attended "with most important and far-reaching results." In view of Hertha Ayrton's adventurous temperament, it can be understood how thoroughly she enjoyed this almost frivolous excursion into a fascinating by-path of scientific exploration.

[1] *Ibid.* for the year 1898.

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CHAPTER XI

THE HISSING OF THE ELECTRIC ARC (1898–1901)

The year 1898 saw the death of Mrs. Marks, after a painful illness through which she was nursed untiringly by her daughter. She had left Portsea soon after Hertha's marriage and settled in London; and Mrs. Ayrton Gould has many pleasing recollections of the kind "Granny" who used to come to see her when she was a little girl, always wearing a mysterious and capacious alpaca pocket under her gown which contained peppermint bulls'-eyes and other treasures of the kind. When her illness became acute in the spring of 1898, Mrs. Ayrton unhesitatingly gave up everything else to take her away to St. Leonards-on-Sea, where they remained together until the old lady died at the beginning of July. It was a great strain upon her daughter, who was pulled in various directions at the time, her home as well as her work making demands upon her which she felt with characteristic devotion she could not fulfil so long as her mother needed her. "I feel as if I were in a bad dream, not able to move either way," Mrs. Ayrton writes to her stepdaughter, who was a great support to her in this crisis and acted as a capable head of the house at 41, Kensington Park Gardens, to which a move had been made in 1891 from Upper Phillimore Gardens.

In addition, the republication of her articles from the

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Electrician weighed heavily upon Mrs. Ayrton's mind. "I work at my book every spare minute," she wrote to Edie, who was to have made an index for it. But the nature of Mrs. Marks's complaint made the task of tending her exceedingly arduous, and there were few spare minutes for her nurse until release came at last to the sufferer, and Hertha was parted from the mother to whose unusual character and capabilities she always claimed to owe so much. On July 12, 1898, she writes from Kensington Park Gardens to her little girl, who had gone for one term to Roedean preparatory school:

"I am coming down on Friday to take you myself to buy a black dress. I shall stay till Monday morning, so we can have a nice little time together. I have been sleeping a great deal since I came home, and am feeling much better and less tired now. I have had such nice letters of sympathy, saying how good and kind dear Granny was always to every one, and how unselfish. Uncle Abe came to-day and told me a great many people, both Jews and Christians, went to the funeral, and they all said that Granny had nursed some of their family, or helped them through some trouble.[1] The minister made a little speech over the grave, saying how dear Granny had been missed when she left Portsmouth, and how she would always be remembered for the kind deeds she had done."

A good rest at home, followed by her interesting experiences at the British Association's autumn meeting (described in the last chapter), soon enabled Mrs. Ayrton to return to her experimental work with fresh vigour. All through the winter of 1898 she was working on the electric arc, ostensibly for the purpose of her book, but really because she was far more concerned in making fresh researches than in publishing in book form what she had already discovered. It was thoroughly typical of her that she detested the dull grind of writing and greatly preferred pushing on to new investigations;

[1] See Chapter I, page 6.

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and this no doubt accounted more than her chronic lack of physical strength for the fact that the book hung about for another three years before it was presented to the public. But she was not idle. This was a period of much activity and scientific achievement; and the opening year of the series, 1899, was a particularly eventful one in her career.

On March 23, 1899, the Institution of Electrical Engineers established a precedent and made a fine break with prejudice by opening their doors for the first time to a woman, inviting Hertha Ayrton to read a paper to their members on "The Hissing of the Electric Arc."[1]

In the Press, the scientific significance of the event was unfortunately somewhat overshadowed by the importance attached to it in relation to the woman's movement. "Woman is slowly but surely achieving the 'open door,'" said one London daily; and the banal remark was instantly repeated in a dozen provincial journals. "Are we about to see a new field of activity and distinction thrown open to the all-conquering sex?" asked another, proceeding immediately to answer its own rhetorical inquiry in the rather pompous "journalese" of the 'nineties: "The recognition by the scientific world of her success marks an epoch in what is, for good or evil, incomparably the most interesting, and in its incalculable consequences the most momentous, movement of the age."

She was described as a little dark-haired, dark-eyed lady, wearing pince-nez, who "created a sensation which perhaps accounted in some degree for the unusually large attendance of young men members"—a deduction on the part of the descriptive reporter

[1] *Journal of the Proceedings of the Institution of Electrical Engineers*, Part 140, Vol. XXVIII.

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which did less than justice to the members of the Institution, who never insulted Mrs. Ayrton by any mark of sex-differentiation and had asked her to give her paper, not in any spirit of sensationalism, but from a purely scientific desire to learn new facts of which she happened to be the sole possessor. The *Spectator*, observing with some superiority that it could "understand the admiration excited by Mrs. Ayrton's lecture better than the surprise," held that women "have a distinct proclivity towards science and mathematics, finding them less exhausting than either history or classics." The final sentence of the same leading article, to some extent foreshadowing the *Spectator's* later opposition to the suffrage agitation, sounds rather *vieux jeu* five-and-twenty years later: "They (i.e. women) will produce a Laplace or a Lord Kelvin before they produce a Paul of Tarsus or a Shakespeare." There was, however, a touch of ironic humour about dragging in St. Paul that any jaded feminist must have welcomed.

An American newspaper added what is generally called the personal touch, in a passage that is quoted here as probably giving the accepted view of woman at the end of the nineteenth century:

> "To those accustomed only to see women engaged in domestic affairs and social life, Mrs. Ayrton's life will be a puzzle; and when it is added that she possesses all the graces and refinements and many of the higher accomplishments, it is more than probable that she will be set down as odd. But those who have the pleasure of her acquaintance declare that she is simply a most charming woman in her home life, a delightful companion in social affairs, and in every way a woman."

Fortunately, as a more enlightened newspaper pointed out, "the eminent scientists present paid her the best compliment possible—they took her seriously." And,

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taking her seriously, they used the long discussion that followed her paper, and was adjourned to a second meeting, as a means of consolidating the new facts she had presented to them and of suggesting points that still needed clearing up in order to confirm her explanation of the jumping and hissing of the arc as a genuine discovery.

Briefly, her paper was intended to communicate the result of various experiments she had made in her search for an answer to the question, Why does the arc lamp sometimes remain silent, and then hum and presently hiss, with the result that although we get a range of brilliant colours, in which purple with a green aureole predominates, there is a marked reduction of steadiness in the illuminating power? The arc light, to the ordinary person, is the bright crude form of electric light known best in the searchlight and sometimes used also for public illuminating purposes; it would be more technically described as the column of carbon vapour which glows between two carbons at a fixed distance apart through which an electric current is flowing; and the effect of the original investigations carried out by Mrs. Ayrton was to show that the hissing and accompanying change in appearance of the arc, and the fall of electric pressure, only took place when the oxygen in the air obtained access to the crater formed in the carbon—which happened when the crater was too large to occupy the end only of the positive carbon and therefore extended up its side, thus coming into direct contact with the air and burning instead of volatilizing. She found that if air was excluded altogether from the arc, the hissing and accompanying phenomena did not occur; further, that if, the air being excluded, puffs of air were then sent against the crater, the hissing occurred; and finally, that if oxygen

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alone were sent against the crater, the same result followed as in the case of air being used. But when nitrogen only, or any component part of air except oxygen, was puffed against the crater, no hissing followed; nor did hissing follow if oxygen or any other of the gases were gently blown through the negative carbon and not allowed access to the crater.

"There can be no shadow of doubt," concluded the lecturer, showing this series of experiments, "that the phenomena accompanying the hissing of the open arc are due to the oxygen in the air getting directly at the crater and combining with the carbon at its surface." The value of her experiments lay, therefore, in showing that if the arc were protected from direct contact with the air, the current could be increased without producing hissing or loss of light—a noteworthy discovery, even if viewed solely in its application to the searchlight. Further problems created by her explanation of the hissing of the arc would be solved, Mrs. Ayrton hoped, by the series of fresh experiments on which she was then engaged.

Much of the attractiveness of her lecture, said the *Daily Telegraph*, was contained in

"the feminine running commentary—outside of and complementary to the printed text—which accompanied wayward experiments, as, for instance, when a peculiar modification of the negative carbon that appears to be due to hissing, the formation of a 'mushroom' at the end of that carbon with a short hissing arc, failed to make its prompt appearance. 'Mushrooms,' observed the lady drily, 'won't grow to order'; and again, 'It's coming now, but I'm afraid it's on the side you can't see.' But she was equal to the unexpected obstinacy of extremely difficult experiments, and always admitted when the desired result was not attained."

In the same account, mention is made of the favourable reception given to the lecture by the audience, and of the commendations of her Chairman, Mr. J. W.

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Swan, who called her paper "a model of scientific method in research"; while she herself was described as being "not one whit dismayed by the masculine criticism of Professor Silvanus P. Thompson and Mr. Morley, who treated the lecturer, not as an amateur, but as an expert who had made a genuine discovery."

In the adjourned discussion, Professor Fleming, Captain Abney and Professor W. E. Ayrton took part, the latter throwing an illuminating sidelight on his wife's method of working, which he said was "to study the known by searching in the unknown." It was not from books, of which, he frankly admitted, she was "profoundly ignorant," that she had come to know the electric arc, but from patient laboratory experiments; and this method, however useless for examination purposes, was far more fruitful than any study of text-books. He thus confirmed again what can be gathered from various sources, going back to quite early days, of Hertha Ayrton's fresh and original manner of research; and it is regrettable that her husband's interesting revelations were cut short on this occasion by the closure of the discussion, so that he had to end with a reference to his wife's theories on the connection between the length of the arc and its hissing, in the dry remark that "arcs are long but nights are short." Mrs. Ayrton replied fully to all her critics, meeting their objections whenever her investigations were sufficiently advanced to enable her to do so, and stating in the remaining instances that the answers depended upon experiments not yet completed.

On the basis of her paper, in conjunction with her articles in the *Electrician*, Hertha Ayrton became recognized as an authority upon the electric arc. The *Electrical Review* (April 7, 1899), after mentioning that her paper marked "a decided step towards the solution of a

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long-standing, difficult and important problem," laments that "we have been continually tantalized by promises that a complete and connected account of her work would shortly appear in book form." But the book still hung fire, for reasons already given, added to the distractions arising out of her growing reputation.

Writing to her stepdaughter Edie, on April 21, 1899, she says: "The editor of *Nature* has written to ask me to send them a popular article on my paper on the hissing arc, so I suppose I must, though how my poor book will ever get done, I don't know." Her husband's insomnia, too, from which he continued to suffer till the end of his life, was troubling him greatly at this time and necessitated their going out of town at week-ends, and afterwards led to their taking a house (Highmead, at Little Baddow, Essex) for this purpose. In the same letter to Edith Ayrton, written from Chislehurst where they were then staying with their friends, the Roses,[1] Mrs. Ayrton goes on to say:

"I think Father is better, but he does not sleep well yet; and cocks and hens and clocks pursue us. . . . I get in a certain amount of work in the morning, and bicycle in the afternoon with Mrs. Rose and the children. Mr. Rose is in town all day, superintending the rehearsal of his new play, 'In Days of Old,' which is coming on at St. James's next Wednesday."

On May 25, 1899, the Institution of Electrical Engineers, then consisting of 3,300 members, all men, established another precedent by electing Mrs. Ayrton to be a full member of their body. They added to the honour thus conferred the unusual distinction of foregoing the customary procedure of first placing her in one of the intermediate categories of students, graduates,

[1] Edward Rose, the writer of plays, who died in 1904, and Mrs. Rose, who survives him and was one of Mrs. Ayrton's most intimate friends.

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or associate members; and the significance of this is demonstrated in the fact that the proportion of full members to other members in the Institution is nominally only about one to five, while up to the time of writing (1925) there has been no other full woman member elected.[1] On May 26, the secretary of the Institution, Mr. W. G. McMillan, wrote further to her as follows:

"I have the honour to inform you that the Council have awarded you an extra premium, value £10, for your paper on 'The Hissing of the Electric Arc.' I should be greatly obliged if, as soon as convenient, you would let me have a list of books or apparatus from which a selection may be made for the presentation."

This premium was formally presented at a meeting of the Institution in the following November, when Dr. Silvanus P. Thompson, the new President, also gave his inaugural address. Among her fellow-recipients of premiums were Mr. G. Marconi for his paper on "Wireless Telegraphy," and Professor Oliver Lodge for one on "Improvements in Space Telegraphy." Another sign of the times occurred in Dr. S. P. Thompson's mention of the new electrical underground railway, to be known as the City and South London Tube. One of the London evening papers became almost lyrical in its appreciation of the fresh honours bestowed upon the "lady electrician," and ended with an effort of imagination in which fact and fiction are so skilfully blended that it is impossible to say where the one begins and the other ends, if indeed the one can be said to have begun at all:

"She has also the literary distinction of being the prototype

[1] In 1919, the second woman member of the Institution was elected as associate member; and there is, I believe, at least one other who is now (1925) qualified for admission as full member, should she make the necessary application.

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of Mirah in *Daniel Deronda*. Mirah, it will be remembered, was beloved by a fair-complexioned Englishman, assistant in a physical laboratory. It is curious that fact should follow fiction this way."

When one makes the effort of memory suggested and finds that of the two men by whom Mirah was beloved, the fair-complexioned one, who did not marry her, was a classical scholar at college and afterwards a painter, while the dark-complexioned one who did marry her was equally unscientific, the curious following of fiction in this particular case becomes "curiouser and curiouser."

At the Royal Society conversazione on June 21 of this year, Mrs. Ayrton, M.I.E.E., besides being one of the lady guests who were invited to Burlington House on this occasion and received by their host, Lord Lister, was also the only woman among the various experts who demonstrated during the evening for the entertainment of the visitors. In the Principal Library, she showed on the screen diagrams of her experiments on the electric arc, and created a sensation which, though amply merited by the scientific value of her demonstration, was, it is to be feared, accorded equally to her position among the novelties of the evening. As the *Daily News* put it, the next morning:

"What astonished the lady visitors, more perhaps than anything else, was to find one of their own sex in charge of the most dangerous-looking of all the exhibits—a fierce arc light enclosed in glass. Mrs. Ayrton was not a bit afraid of it. She calmly showed how, by excluding air from the light, its unpleasant hissing could be prevented; and, throwing a picture of the burning carbon on the screen, she made the reason evident to the dullest."

Apparently, however, all contemporary women were not so much stunned by the spectacle of a woman's success in physics as to be rendered incapable of appre-

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ciating the scientific value of her achievements; and when the meeting took place in London, at the end of the same month, of the International Congress of Women, Mrs. Ayrton was asked to preside over the section dealing with the work of women in the physical sciences. The Congress was a noteworthy gathering of women, no other meeting of it having taken place since it first met at Chicago, in the year of the Exhibition, 1893. Three hundred delegates came from all parts, and some four hundred papers were read, dealing with science, the drama, literature, economics (generally included then under the vague title of social reform), politics, and other subjects of interest to intelligent women. The Countess of Aberdeen presided, and among British representatives who took part in the discussions were several from the colonies, besides others well known in this country, such as Mrs. Alfred Booth, Mrs. Creighton, Lady Laura Ridding, Mrs. Sidney Webb, Mrs. Barnett, Lady Henry Somerset, Mrs. Fawcett, and many more. The foreign delegates included Miss Susan B. Anthony and the Rev. Anna Shaw, from the United States; Baroness von Sutten, the famous German pacifist; Mlle de St. Croix and Mlle Sarah Monod, from France, besides others from different countries.

Most of the Chairwomen of the various sessions were Englishwomen, who at that period seem to have led the way in knowledge of procedure and capacity for conducting a meeting. Among them, Mrs. Kendal presided over the drama section, and Lady Frances Balfour over that dealing with woman suffrage, while the Duchess of Portland took the chair at a meeting for the protection of birds and animals. The newspapers were naturally full of the doings of the women who crowded the various London halls set apart for

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the Congress; and among the entertainments provided for lighter moments was a reception given by Mrs. Ayrton's old friend, Mrs. Hancock, at her house in Queen's Gate.

Much popular interest was aroused by the science section, over which Hertha Ayrton presided in the smaller Westminster Hall,[1] scientific women being in the eyes of the general public still among the newest of new women. Papers were contributed by Miss C. Raisin on geology, by Miss Dorothy Marshall on chemistry, by Mrs. McKillop and Mrs. Maunder on general physics, and by Miss Ethel Sargant on botany; and there were of course many more besides. Foreigners were not so well represented in this section as their position abroad warranted; for in Germany, for instance, Fräulein Elsa Neumann, whose subject was electrochemistry, had just taken her D.Sc. degree in Berlin and was the first woman in Germany to do so; while in France, Madame Curie was so distinguished a physicist that Mrs. Ayrton had made a special though unsuccessful effort to secure her presence at the Congress. As this is the first instance of a communication between these two women of kindred careers, who became later warm personal friends, and by reason also of the allusion made in it to the experiments leading up to Madame Curie's discovery of radium, the French letter of refusal is here given in full:

"Je regrette beaucoup de n'avoir pu accepter votre aimable invitation au Congrès International des Femmes. La question du développement intellectuel et de l'affranchissement social des femmes m'a toujours beaucoup intéressée, et j'aurais pris part à votre réunion avec le plus vif intérêt. Malheureusement je n'ai

[1] Afterwards known as the Caxton Hall, and the scene of many militant suffrage demonstrations at which Mrs. Ayrton, in a different capacity, was also present.

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plus le temps de prendre les dispositions nécessaires pour m'absenter, d'autant plus que je viens de faire un voyage de quelques jours. . . . Excusez-moi donc, je vous prie, si ma réponse s'est fait attendre. Je vous prie aussi, Madame, de m'excuser de ne point vous envoyer une communication écrite pour votre Congrès. Le temps m'a réellement manqué pour essayer de faire un mémoire méritant d'être lu à l'Assemblée du Congrès. Vous êtes bien aimable de vous être donnée la peine de m'écrire deux fois pour m'inviter au Congrès. Si j'avais reçu cette première invitation, j'aurais eu assez de temps devant moi, et je serais certainement allée à Londres. Je suis heureuse d'apprendre que vous vous êtes intéressée aux substances radioactives (qui déchargent l'électroscope chargé) et que M. Becquerel vous a montrées. C'est un sujet de travail qui nous occupe en ce moment, mon mari et moi, et qui nous intéresse beaucoup tous les deux. Veuillez agréer, Madame, l'assurance de mes sentiments les plus distinguées. M. CURIE."

Many interviews with Hertha Ayrton appeared in the Press at this time, one of which, in the *Ladies' Field* (July 15, 1899), includes a reference to the activities of her friends, Sir William and Lady Huggins. The writer of this article tells incidentally a pleasant story of Lady Huggins, whose observations of the fixed stars had caused her name to become known to astronomers everywhere. A friend, who had made some observations in the same direction, asked Lady Huggins how long it would take him to get his eye into a normal condition for testing incandescent lamps by the "Wedge" method, in a dark room, after working in a factory lighted by arc lamps. "I think," Lady Huggins responded with her gentle, grave smile, "that it could be managed by sitting in a dark room for about a fortnight."

Mrs. Ayrton's own contribution to the Science Section of the Women's International Congress was a paper discussing the question of available openings for women as electricians. She thought there was a genuine opening for women in the making of electrical instruments,

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in which field the demand at the moment exceeded the supply, firms being unable to execute their orders for want of trained labour. M. Ferranti, the well-known electrician, she pointed out, always employed women workers in this capacity.

In the following year, 1900, Mrs. Ayrton again spoke to scientists of many nations, at the International Electrical Congress in Paris. The President of the Congress, M. Mascart, wanted English experts to read reports on their own particular branches of electrical engineering, and Professor Perry, then President of the Institution of Electrical Engineers, suggested to Mrs. Ayrton that she should read one on the electric arc. She told some one afterwards that in reading this paper,[1] which was in French, she felt much less nervous than on previous and similar occasions. She laughed, however, in denial of the idea that her fellow-scientists viewed the incursion of a woman into the sphere of electrical research as an intrusion. "I have always found them most kind, helpful and obliging, always glad to do all they can for me," she declared warmly. Indeed, the enlightened and generous attitude of the Institution of Electrical Engineers gave her reason for saying this; and her view of the situation seemed to be endorsed at the preliminary meeting of the British Association, who assembled at Bradford just after her return from Paris in September, 1900.

Her old companion and cousin, Professor Marcus Hartog, D.Sc., F.L.S., F.R.H.S., moved at this preliminary session that in future women members of the British Association should be eligible for the general

[1] "L'Intensité lumineuse de l'Arc à Courants Continus" ("The Light emitted by the Continuous Current of the Electric Arc"), published in the *Rapports Préliminaires du Congrès d'Électricité* (1900).

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and sectional committees. He pointed out that women were no longer amateurs in science, and the old reasons for excluding them from the active counsels of the Association did not now exist. Sir John Evans and Sir W. Roberts Austen sought to amend his resolution, urging their listeners, in the familiar language of prejudice, to proceed with caution and only to admit women to the sectional committees if they were already members of the general committee. This reactionary advice was received with a good deal of hilarity, and was rejected by fifty-two votes to fifteen, the majority having been greatly impressed by the statement of Professor Silvanus Thompson, the seconder of the motion, to the effect that at the recent Electrical Congress in Paris, which he had attended, "undoubtedly the most remarkable paper was one read by a lady, an English female electrician." The Press generally hailed the innovation thus made as a sign that the British Association, to quote one newspaper, had "turned its back on such nonsense as the exclusion of women on the ground of sex."

The *Electrician* agreed with Professor Silvanus Thompson in his estimate of Mrs. Ayrton's Paris paper, "one conclusion of which should have an important practical bearing, for she points out that long arcs are uneconomical, and the most economical arc should be a short one with large currents, though not so short as to produce hissing." It was equally well received in France; especially by the eminent French electrician, M. Blondel, with whom she was associated in a special vote of thanks from the Section of the Paris Congress in which it was read. M. Blondel was prevented by ill-health from attending the Congress, but read her paper afterwards and wrote to her in September, 1900, full of praises for a contribution "si pleine d'aperçus ingénieux et nou-

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veaux," adding his declaration of admiration for her "beaux travaux" and for her "intelligence si pénétrante (bien rare pour une dame, en France aussi bien qu'en Angleterre)." But his language became much more discriminating when he proceeded to a consideration of her conclusions, on which he made, not criticisms, as he carefully represented, but suggestions as to points that appeared to him not fully proved. Her French colleagues, like most of those in her own country, however ready with their compliments, paid her in addition the only one that counted, that of taking her seriously as a scientist.

The year 1900 ended with the annual dinner of the Institution of Electrical Engineers, which Mrs. Ayrton attended as a matter of course, being placed next to Professor Larmor, F.R.S., and only two seats away from her old Girton coach, Mr. R. T. Glazebrook, F.R.S. But naturally, the presence of one woman in a company of more than three hundred men did not pass without notice. Many newspaper correspondents made merry at the expense of the after-dinner speakers, who tried various ways of addressing their audience, from the "Madam, my lords and gentlemen" of Sir John Wolfe-Barry to Mr. Swinburne's "Mr. Chairman, *lady*, and gentlemen"; while some avoided the difficulty by leaving her out altogether. *Tit-Bits* did as *Tit-Bits* would, and inserted the following among its general-knowledge questions, that week—"Has any hotel dinner-party consisted of 359 men and one woman?"—but answered it seriously enough, being careful to point out that Mrs. Ayrton's presence at the dinner "was not a matter of favour, but of right." Mrs. Ayrton herself was naturally not in the least perturbed by the sensation she appeared to be causing, and when asked if she did not feel nervous at dining alone with

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men, replied sensibly enough—"Why should I? When I go out to dinner, I always have a man on either side of me!"

Although the Royal Society had already made one innovation in allowing a woman to show experiments on a ladies' night at Burlington House, they apparently did not yet feel able to proceed to the length of allowing a woman to read a paper at one of their meetings. They were quite ready, however, to avail themselves of the knowledge in her possession; so a compromise with tradition was effected when Professor Perry, F.R.S., read a paper written by Hertha Ayrton on "The Mechanism of the Electric Arc,"[1] at a meeting of the Royal Society on June 20, 1901. A reference to this paper, in a letter written to her stepdaughter during one of the week-ends at Highmead, is an amusing comment on the way Professor and Mrs. Ayrton helped each other without giving up their independence:

"Everything is going on as usual. Father is boiling down my paper to the last degree of compression, but I don't let him do it alone. I am watching the case on my own behalf, and he has got to take it seriously, and not as if it were a copy of *Tit-Bits*. There has been no serious discussion yet, 'but the time *will* come'!"

In her paper, she described further experiments made with the object of penetrating a secret that, "ever since the first discovery of the electric arc, a hundred years ago, has been one of the most fascinating mysteries of science."

A satiric entry occurred in the issue of *Who's Who* for the year 1902, stating, in the course of a short biographical notice of Hertha Ayrton, that she had published numerous papers of which one had been read for her before the Royal Society in 1901, but "being of the

[1] *Philosophical Transactions of the Royal Society of London*, 1902 (Series A, Vol. 199, pp. 299–336).

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female sex, the conservative regulations obliged her to depute a man to demonstrate her original research work." It is only fair to remember that at the beginning of the twentieth century, as to-day and always, movements did not proceed equally all along the line, and that when women's progress seemed to halt obstinately at one point, it sometimes advanced surprisingly at another. Hertha Ayrton had proved this incongruity in her own case. But although her next paper before the Royal Society was read by her in person, this picture in *Who's Who* of a learned society of men, willing to learn from a woman whom they could not yet admit to their platform except by proxy, does rather suggest that her tribute to the encouraging welcome she had received from fellow-scientists was not lacking in generosity at the time that she paid it.

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CHAPTER XII

MARGATE AND A ZINC BATH (1901–4)

In the autumn of 1901, Professor Ayrton went to Bad-Nauheim to take the waters, accompanied by his daughter Edie. After leaving school, Miss Ayrton had been for about three years a student of Bedford College, and was now beginning to devote a good deal of her time to writing.[1] A little earlier, her stepmother had written to congratulate her on the acceptance of her first short story (probably "Jacky," which appeared in the *Pall Mall Gazette*) and took the opportunity in the same letter to press her to waste no more of her time over household matters, which had hitherto occupied her in addition to a good deal of social reform work. Mrs. Ayrton again wrote to her about her literary work at Bad-Nauheim, making a reference to Mr. Israel Zangwill, to whom Edie not long afterwards became engaged.

"Nelly read the 'Shroud of Desire'[2] the day it came out, coming down to Highmead, and never noticed your name at the end! . . . I sent your MSS. to Mr. Zangwill; it is very good of him to look after them, and very nice of him to write to you every day, though I cannot say I think he displays a *large* amount of

[1] *The First Mrs. Mollivar* (1905) was her earliest novel. Before that, she had brought out a collection of childhood reminiscences, called *Barbarous Babes*; and her later novels include *Theresa*, *The Rise of a Star*, and *The Call*, the last of which deals with militant suffrage and the war.

[2] A short story which appeared in the *Westminster Gazette*.

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self-denial in this. I have no doubt he gets some small modicum of enjoyment out of it, too."

About this time, Edie made her stepmother very happy by sending her a present of a diamond star, accompanied by a letter, the nature of which may be gathered from the following answer to it:

"My dear, dear Edie,—How could you! It was very wrong of you to spend such untold sums in such a way. It must have cost mints of money, even in spite of Sir William Crookes's 'expert assistance'! It was very good of you, dear, but you know it was quite unnecessary. There is no need for any talk of what I have done for you, any more than there need be from Barbie. Without any wish to take your mother's place, I have, I hope, been a friend to you, and you have been equally one to me, and between friends there are no obligations; each is naturally on the alert to help the other in every possible way. And you know that if I have been able to devote myself to my work during the last few years it has been very largely owing to you, as I am fully aware, and so our aid has been mutual—as it should be. All the same, the star is lovely, and I am very proud to be its possessor. Barbie presented it to me the moment we arrived; she couldn't keep the secret another minute! Father sat gazing at it in rapt admiration and pronounced a panegyric on you worthy of a place on your tombstone. It is a real thing of beauty; I shall wear it at the Lauder Bruntons' on Wednesday. Yours ever, with love,—Hertha Ayrton."

In another letter to Edie, Mrs. Ayrton talks a good deal about her own daughter, who had just begun to attend Notting Hill High School and was very happy there. Apparently, Barbie had suddenly discovered that she was, after all, "made" for something besides "climbing and running and swimming," for her mother writes:

"Barbie is taking to her school work as she never has before. I am very glad I sent her there; for the first time in her life she is working seriously, and consequently she is enjoying it instead of finding it a grind. She is splendidly well, full of spirits and throwing her whole energies into her work. I am giving her coaching in all the back work of the mathematics which she has more

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or less forgotten, and she is eager to have it, though it means two or three hours a day extra work, sometimes. In fact, never was there such a metamorphosis!"

It was a metamorphosis in more ways than one; for Barbara appears to have suffered at this time, as most children do on going to school, from an attack of conventionalism, which she expressed, to the amused astonishment of her parents, by exclaiming with a sigh, one day: "I do wish mother had a boudoir, all filled with yellow satin furniture, instead of a laboratory—like the mothers of other girls!" But this frivolity must have been only skin-deep; for only a short time afterwards we find Mrs. Ayrton writing her a letter that more nearly suggests the Barbara Ayrton Gould of later days:

"I am very glad to hear you are taking an interest in politics, and that you read the newspaper and talk about it. I don't know why we don't talk about politics more at home; perhaps because we are more interested in other things. But I *am* interested in my fellow-creatures, which is, after all, what politics are; and you shall read the papers to me in the evening and we will discuss them together. . . ."

It must have been a recurring source of trouble to Mrs. Ayrton that she was so often divided in her sympathies at this period of her life; for her husband continued to suffer from insomnia after his return from Bad-Nauheim, and was even obliged to give up his work at the Central Technical College for the whole of the autumn term of 1901, during which they were in rooms together at Margate. This necessitated their leaving the two girls alone together in the London home. In order to secure greater quiet, a move was decided upon; the house in Kensington Park Gardens was let, and in the following autumn (1902) the family went to live at 41, Norfolk Square, which remained Hertha Ayrton's home till the end of her life.

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The visit to Margate involved a break in her experiments on the electric arc, which from their nature could not be conducted away from the college laboratory. So, once again, Mrs. Ayrton had to choose between her work and her human claims, though on this occasion it could hardly be called a conscious choice, her personal inclinations being the overwhelming factor in her decision. She found some immediate compensation for her sacrifice of experimental work in the leisure it afforded her for the completion of her long-delayed book on the electric arc. But the outstanding result of the Margate visit was the inspiration she unexpectedly gained there for a totally new piece of scientific investigation.

It seems to have been always impossible for Hertha Ayrton to rest with her hands before her. Once, when she was prescribed some weeks of mental repose for the sake of her health, she lost no time in repining but started to design and execute a very beautiful piece of fine lace appliqué work that still exists as an example of this vitality of hers, which, whenever forced out of its familiar channel, invariably found a fresh outlet. So when it seemed as though for the next three months it was to be her lot to pace the sands at Margate with her husband, she at once interested herself furiously in the sands at Margate. One who was afterwards closely associated with her in her experiments on wave-motion always says, with some shrewdness, that she might not have noticed sand ripples at all but for the unusual circumstance of never having seen a sandy beach as a child; the phenomenon therefore broke upon her mature mind as a novelty and almost as a discovery. Whether this was so or not, it is certain that she had not been idling long at Margate before she was struck by the regularity of the sand ripples there. From this she

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proceeded to notice that, although parallel to the line of the breakers, the ripples did not appear to be produced where the waves broke on the shore but were formed entirely under water and were washed out by the retreating tide. This—a fact already observed and investigated, as she afterwards learned—at once set her speculating on the origin of sand ripples and their probable bearing on coast erosion, on the existence of sandbanks, and kindred phenomena. In fact, she had found the required new outlet for her baffled scientific energies.

It is amusing to picture the face of the Margate landlady when her apparently sane lodger returned from her afternoon walk, one day, and said to her without any warning or explanation, "I will have my bath in the sitting-room after tea, please." This sublime disregard for the unprepared mind of the ordinary unscientific person was typical of Hertha Ayrton's absorption in her work. Her household in London had learnt by this time to be surprised at nothing; though she sometimes put the members of it to severe tests, as, for instance, on the occasion when her stepdaughter was giving one of her small dances at Kensington Park Gardens, and the guests were suddenly amazed to see an abstracted lady in an overall emerge from the laboratory at the top of the house (where she was using a good deal of current at the moment), and, muttering to herself "The main fuse will go!" proceed to switch off several of the electric lights without apparently noticing the presence of the revellers.

But the shock incidentally administered to the Margate landlady was epoch-making in other directions. The experiments in sand and water that resulted from the appearance of the bath in the sitting-room, accompanied by smaller tests in soap-dishes and pudding-

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basins, and other appliances commandeered from the astonished proprietor, marked the beginning of a long series of investigations into the formation of sand ripples and vortices in water, leading to important discoveries which, applied to the air, had a far-reaching effect when the Great War of 1914–18 was being waged. There was a long way still to go from the zinc bath in the Margate lodging-house to the "Ayrton fan" in the trenches of Flanders; but the inventor of the latter had set her foot upon the road before the Christmas of 1901.

Meanwhile, her book was actually approaching publication at last. Her publishers, the *Electrician* Printing and Publishing Company, must surely have been the most patient firm of publishers on record, for they had already waited five years for her "copy" when she wrote to Edie in May, 1900: "I have finished revising my last chapter; there are a good many figures to be drawn for it, however, and an appendix and preface which will take some time, so I am not free yet." Her dislike to this kind of work still tempted her to place anything and everything else before it; so it was not until December, 1901, that she wrote to Barbie from Margate: "There is a temporary lull in rippling because of preface and proof, but it will begin again as soon as these are off"; and even after this allusion to the apparently finished work, she did not put the final touches to it for some weeks yet. It was at last published early in 1902. One of the presentation copies autographed by her is still in existence; it belongs to Mrs. Hancock and bears an inscription that recalls early happy days in Karl Blind's house at Hampstead: "To my oldest Friend, my first Inspiration."

Hertha Ayrton's book, *The Electric Arc*, was based upon various papers read to the British Association, the

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Royal Society and other bodies, as well as the articles which had appeared in the *Electrician*, together with amplifications founded upon later experiments. It had a very favourable reception, at once taking its place as the recognized text-book on the subject of the electric arc. Mr. A. P. Trotter, in the course of an account of the scientific work of Hertha Ayrton, which appeared after her death in *Nature* (January 12, 1924), describes the book as being "the only complete history of the electric arc, fully documented, from the time of Sir Humphry Davy." Referring to the accident which originally led Mrs. Ayrton to make her own investigations into the electric arc, and ultimately her own discoveries, he observes: "When a negro servant lighted a fire with Professor Ayrton's paper . . . at Chicago in 1893, he little knew that he was rendering a service to science and to electrical engineering." The article goes on to explain how:

"Having access to the laboratory note-books, she began the whole research afresh, and not only obtained consistent results, expressed in curves and equations, but also interpreted the work of previous investigators, and, in those sections with which I am most familiar, presenting them more lucidly and correctly than the original author had done."

This critic defines the book as being rather technological than of "fundamental scientific consequence," so that "the outcome was more practical than theoretical" —a description that illustrates once more Mrs. Ayrton's habitual tendency to emphasize the practical application of all the discoveries she made by experiment. Mr. Trotter adds that she also "made many tracings of arcs projected with a magnification of ten times, in her study of the shapes of carbons, and this study led to important results."

The book attracted considerable attention, too, in

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scientific and engineering circles abroad, immediate applications being made for translation rights, while a German review of it in the *Electro-technische Zeitscrift* (January 1, 1903) speaks with enthusiasm both of the original conclusions reached by the author and of her clear exposition of all that had been previously discovered about the electric arc; the reviewer ends by recommending the book "to all who are in any way concerned with the understanding" of the subject. One of her American reviewers—there was an American edition issued by Messrs. Van Nostrand, New York—after dealing with the "striking and important contributions to our knowledge" contained in the passages relating "to hissing arcs and to the effects produced by what Mrs. Ayrton calls arc vapor and arc mist," warmly commends her for having taken "the trouble to present in connection with her own work a fair and lucid description of what has been done before in the same field."

It was largely owing to this painstaking method of correlating her own work with that of her predecessors that Hertha Ayrton's book became, not only a record of original investigations that considerably advanced our knowledge of the electric arc, but also the classic work upon the arc, a position which, in regard to the carbon arc, it has retained to the present day. It was the pioneer work on the whole subject, and, although to some extent superseded in the realm of the metallic arc, owing to the amount of recent research work which has been necessitated by the big advance in industry made by metallic arc welding processes, that part of the book which deals with her own special branch, the carbon arc, is still regarded by electrical engineers as the authoritative work on that subject.

The Ayrtons were still at Margate when, in November,

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1901, the Royal Society medal was bestowed upon Professor Ayrton, for his "contributions to electrical science," a definition of his activities which may be held to embrace, not only original research, but also the substantial services he had rendered to scientific education in connection with his work at the Finsbury Technical College, and still more as Professor of Applied Physics at the Central Technical College, South Kensington (or City and Guilds (Engineering) College, to give its full modern name), which owed its existence largely to his energy and initiative. Of his pioneer work in Japan, and that of his great friend and partner Professor Perry, it was said by Professor Clerk-Maxwell, that "they had moved the centre of gravity of electrical science greatly eastward." In presenting the medal, Sir William Huggins, then President of the Royal Society, spoke of Professor Ayrton's contributions to science as being grouped roughly under two heads: "He has carried out a large number of researches in pure physics, and he has taken a very prominent part in the development of the application of electricity to industry which has been so remarkable a feature of the closing years of the nineteenth century."

The delight in the Margate lodging, when the announcement came from the Royal Society, was described by Mrs. Ayrton in a letter to Edie on November 8, 1901:

"Isn't it delightful about the gold medal for Father? Mr. Swan was putting him forward, and Professor Perry was backing him up, so to say; and we heard he had little chance, as the Council wanted to give it to some younger man. So late as yesterday, Professor Perry evidently feared Father was not going to get it, because he wrote him a most charming letter which arrived this morning, saying that Father's work deserved, not one medal only, but many medals. However, last night, a telegram came, signed Swan and Perry, congratulating him on having got it, so that's

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all right. Father won't show that he is pleased; but he is—very. More pleased at Professor Perry's letter than at the medal, I think!"

About this time, the attempt was made to secure the nomination of Hertha Ayrton as a candidate for the Fellowship of the Royal Society, an attempt that failed, not so much because she was a woman as because she was a married woman. When her paper on "The Mechanism of the Electric Arc" was read before the Royal Society in June, 1901, those Fellows who were anxious to promote her candidature followed the usual formula and sent in the necessary certificate to the Council. This was signed by the following: Professor J. Perry, Sir W. de W. Abney, Professor Everett, Professor Henrici, Sir William Preece, Sir William Tilden, Sir Norman Lockyer, Professor Meldola, and Professor Carey Foster. There seemed at first a reasonable probability of her candidature being accepted; and had that been the case, there would have been little doubt as to her election. It was a favourable moment for the attempt. A good deal of criticism was then being expressed in public, in regard to the exclusion of properly qualified women from the learned societies, such as (besides the Royal Society) the Geological and Chemical Societies, the Royal Astronomical Society, the Society of Antiquaries and the Linnean Society. The Royal Society was not prepared, however, to take the initiative in the matter; for on February 28, 1902, the following letter was received by Professor Perry, who had been foremost in the wish to see Hertha Ayrton privileged to write "F.R.S." after her name:

"Dear Sir,—A Certificate in favour of a married lady as a candidate for the Fellowship of the Society having been received here, the President and Council, before registering or reading this Certificate, decided to take Counsel's opinion as to their powers under the Charters with respect to the candidature of women. We are

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instructed by the President and Council to send you a copy of the case submitted, and Counsel's opinion thereon; and to state that, in accordance with that opinion, the Certificate above referred to has not been registered or read. We are, faithfully yours, M. FOSTER, J. LARMOR (Secretaries, Royal Society)."

The case submitted to Counsel by the President and Council of the Royal Society was impartially stated. On the one hand it was made clear "that no lady ever has been elected a Fellow of the Society, and . . . the archives of the Society, so far as can be ascertained, contain no evidence that either she [i.e. Mary Somerville] or any other woman was ever nominated for the Fellowship"; while, on the other hand, it was also pointed out for the guidance of Counsel that "the Charters do not appear to contain any words which would not refer to women equally with men. The Fellows are termed 'sodales,' which does not seem to be confined in meaning to men."

Counsel's opinion, signed W. O. Danckwerts and R. J. Parker, was quite definite. The essential part of it ran as follows:

"(*a*) The Council should not allow the lady in question to be nominated or direct the Certificate in question to be registered or read.

"(*b*) They should direct that the Certificate be not registered or read on the ground that the candidate, being a married woman, is not qualified for election."

Counsel further point out that the wording of the Charters (dated respectively 1662, 1663, and 1669) was doubtful with regard even to unmarried women; and so, although a Statute could be passed rendering unmarried women eligible for election, the validity of such a Statute might be questioned. But no Statute could make married women eligible, according to Counsel's opinion, so that, under all the circumstances,

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"it would be wiser to apply for a supplemental Charter, rather than to proceed by way of passing a new Statute, the validity of which, if passed to admit unmarried women, might, having regard to the doubtful construction of the existing Statutes, remain a matter of uncertainty."

This opinion made it quite clear that the Royal Society certainly could not within its present Charters admit a married woman as Fellow, and probably could not admit an unmarried one. The President and Council were therefore perfectly correct in declining to read or register the Certificate nominating Hertha Ayrton as candidate for a Fellowship. What they could have done, and what it was hoped they would do in a much wider circle than that of Professor Ayrton and his friends, was to apply for a supplemental Charter enabling them to elect properly qualified women as Fellows, should any be nominated as candidates. There would have been nothing extraordinary in adopting such a course. The Linnean Society (founded in 1788), finding themselves in the same constitutional difficulty, did actually apply in 1903 for Royal sanction to a supplemental Charter, enabling them to elect Fellows "without distinction of sex." This supplemental Charter was granted on April 8, 1904, their by-laws were altered accordingly, and on November 17, 1904, sixteen women were proposed as Fellows of the Linnean Society, of whom eleven were admitted on January 19, 1905.

Among the first women Fellows of the Linnean Society was Miss Ethel Sargant,[1] the distinguished botanist; and, with the consciousness in her own mind of exclusion from the possession of the highest honour of the

[1] Miss Ethel Sargant, F.L.S., Hon. Fellow Girton College, died January 6, 1918.

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scientific world, Hertha Ayrton must have particularly enjoyed the occasion on which, a little later, she was asked at a public dinner to propose the health of the Linnean Society, coupled with that of Miss Ethel Sargant. "Nothing pleased me more," she said in the concluding passage of the speech she then made, "when I heard of the generous and open-minded action of the Linnean Society, than the knowledge that Girton was to be represented in it by Miss Sargant;" and she told how a well-known Fellow of the Linnean Society, who was prominent in working for the abolition of the sex barrier in that organization, had said to her that this reform was all the more desirable in that it would mean the admission of Miss Sargant.

But the Royal Society declined to take the opportunity thus presented to them, and failed to apply for a supplemental Charter. It is therefore with rather mixed feelings that one learns, more than twenty years later, that time has effected what reason and enterprise failed to effect in 1902. On November 21, 1922, after the passage of the Sex Disqualification (Removal) Act, consequent upon the political enfranchisement of women, Miss Haslett, the secretary of the Women's Engineering Society, wrote to ask the secretary of the Royal Society what the existing position was in regard to the candidature of women Fellows; adding that the various Engineering Institutions had now opened their doors to women. A reply came to the effect that since the Act mentioned was passed into law the question of the admission of women had been "receiving the attention of the Council of the Society." For reasons that do not concern us here, the secretary of the W.E.S. did not pursue the subject until the present year (1925), when she again approached the secretary of the Royal Society for a definite reply to her question, and received the

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following interesting communication on April 8, 1925:

"DEAR MADAM,—In reply to your letter of April 7, Council, as I stated in my letter of December 7, 1922, took into consideration the question of the admission of women to the Society. There was a general opinion that women were really eligible provided, of course, that their scientific attainments were of the requisite standard, but to make the matter quite sure we took Counsel's opinion, and were informed that women were, as we had thought, eligible under the Charter and present Statutes of the Society. Yours faithfully, J. H. JEANS."

Much water has rolled under the bridge since 1902, and Mrs. Ayrton herself helped to set the current flowing that bore with it the enfranchisement of women and the enabling legislation that accompanied it. But there must be many, both within and without the ranks of the Royal Society, to whom it will always be a matter for regret that no further attempt was made during the lifetime of Hertha Ayrton to create her the first woman Fellow of that body.

All through the years 1902 and 1903 Mrs. Ayrton was working at her experiments with sand and water, and she spent the summer holidays of 1904 at Kingsdown, on the coast of Kent, observing the formation of the Goodwin Sands and the currents in their neighbourhood. The summer of 1903 was memorable for the meeting in London of Mme Curie and Mrs. Ayrton, which resulted in a friendship between the two women physicists that grew stronger with the years and lasted until death put an end to it. In a later communication to the Press, written to vindicate her friend's reputation as the actual discoverer of radium,[1] Mrs. Ayrton tells the following incident:

"It was in 1900, I think, that, coming into my husband's sitting-room at the Central Technical College, I found awaiting him M.

[1] See Chapter IX, page 117.

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Becquerel, who, after some conversation, asked for an electroscope, which he proceeded to charge. He then took a paper out of his pocket containing a small quantity of powder, which he held at about a foot from the electroscope, which promptly discharged. After charging and discharging it several times, I asked him who had discovered this wonderful stuff, and what it was called. 'Madame Curie. Radium,' he replied, and dilated on its extraordinary properties till my husband arrived."

Both Mrs. Ayrton and her husband were of course present when, in June, 1903, at a meeting at the Royal Institution, Albemarle Street, Professor Curie read a paper which created an enormous sensation, describing his wife's discovery of radium and the experiments that led up to and followed its discovery. Below the platform sat the woman who was responsible for this epoch-making achievement but could not personally convey it to the audience, for the Royal Institution of those days did not allow a woman to read a paper.[1] The lecturer made it perfectly clear in his paper that the discovery was his wife's, as she herself had made it clear in her thesis entitled "Recherches sur les Substances Radioactives,"[2] written to obtain her Doctor's degree at the University of Paris—and he added that both he and M. Bémont had afterwards helped her to

[1] This particular disability of women has since been removed, and a lady, Miss Joan Evans of St. Hugh's College, Oxford, read a paper at the Royal Institution on "The Jewels of the Renaissance" on June 8, 1923.

[2] "Je précise, pour terminer, quelle est ma part personnelle dans les recherches sur les substances radioactives . . . j'ai découvert que certains minéraux possèdent une activité qui ne peut s'expliquer par leur teneur en uranium et en thorium. J'en ai conclu que ces minéraux pouvaient renfermer une substance radioactive différente de l'uranium et du thorium et plus fortement radioactive que ces métaux. En collaboration avec M. Curie, puis avec M. Curie et M. Bémont, je suis arrivée à extraire de la pechblende deux substances fortement radioactives: le polonium et le radium." *Recherches sur les Substances Radioactives* (published 1903).

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extract radium from pitch-blende. But the unfortunate fact of Mme Curie's exclusion from the platform on this dramatic occasion, added to some difficulty on the part of the Pressmen present in understanding Professor Curie's explanation of the position, occasioned the birth of an error which has never wholly died in this country.

After their return to Paris, Mme Curie wrote the following letter to Mrs. Ayrton:

"Nous voici de retour à Paris, et je prends la liberté de vous écrire pour vous remercier de votre grande amabilité à notre égard et de la charmante soirée que nous avons passée dans votre maison et qui constitue un des plus jolis souvenirs de notre séjour à Londres. . . . C'était également pour nous un grand plaisir que de faire la connaissance de tant de savants distingués et, en particulier, de pouvoir causer avec vous et de vous remercier de m'avoir offert d'une façon si aimable l'hospitalité chez vous. Permettez-moi, chère Madame, de vous dire aussi, que j'ai été très heureuse de faire la connaissance de M. Ayrton, et je garde le meilleur souvenir de vos deux filles si charmantes et si séduisantes par leur simplicité et leur intelligence, avec lesquelles j'ai eu le plaisir de causer pendant la soirée que nous avons passée chez vous. . . . Agréez, etc., M. Curie." [1]

In 1903, Professor Ayrton's daughter became engaged and married to Mr. Israel Zangwill, whom Mrs. Ayrton first met in 1895 at Mrs. Hartog's house, when she invited him to dinner to meet her husband, who, she mentioned, shared her admiration of his books. He and Edie were great friends for some time before they became formally engaged, and it was largely through his encouragement and help that she took steps to get

[1] In the autumn of 1903, the Royal Society conferred the Davy Gold Medal upon M. and Mme Curie conjointly, which was at least a half-recognition of her work, and remarkable further for being the first occasion on which a woman had been thus honoured, even conjointly with her husband, by the Royal Society.

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her stories published, and, indeed, realized that it was within her power to succeed as a writer.

Israel Zangwill was then nearing the height of his fame. He was already well known for what many of his admirers regard as his best literary work—the "ghetto" studies, to be found in collections of short stories and sketches as well as in his long novel *The Children of the Ghetto* (1892). In all of these he revealed the drama of Jewish life with a beauty and truth that rapidly established his reputation both here and in the United States. A dramatized version of *The Children of the Ghetto* had also been given in America before this, where it was at least a decided artistic success; but when the American company brought the play to London, unfortunately in the black week of the Boer War, the result was summed up in one of the author's characteristically witty remarks as "small profits and quick returns." As a dramatist Mr. Zangwill was then on the threshold of success, *Merely Mary Ann* being the only important play of his that had been produced, and that only in America (it appeared here first in 1904): his big dramas, including *The Melting Pot*, were still unwritten.

He was an ardent supporter, then as afterwards, of the repatriation of the Jews, and under the flag of Zionism gave indications of the imaginative and spiritual insight that is indispensable in those who work for a cause and that made him, a few years later, one of the most inspired supporters of woman suffrage. There was thus every element of a happy marriage in his union with Edith Ayrton, who shared his views on many subjects, being an ardent social reformer herself, and who also added to their mutual equipment a fund of practical common sense of which no one was more aware than he, the absent-minded dreamer of the Ghetto. A tale he was

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very fond of telling in the Ayrton circle about his small son illustrated his sense of what he owed to his wife in this respect. Seeing a snail in the middle of the road, near Far End (their house at East Preston, Sussex), Mr. Zangwill removed it humanely to the hedge. "What's that for?" asked the child, then a mere baby. His father explained that if the foolish snail continued to wander about in the middle of the highway it would certainly be run over. "Then why doesn't he get a wife to look after him?" asked the little boy, drawing upon his daily experience of woman's sphere in married life.

In November, 1903, Edith Ayrton, as one reporter described it with a picturesqueness that the present writer envies but cannot hope to emulate, "leapt from one end of the alphabet to the other and became Mrs. Zangwill." They went to Spain for their wedding journey; and while they were abroad, a long letter written to Edie by her stepmother (December 15, 1903) provides a useful commentary on Mrs. Ayrton's activities at home:

"I went to a dinner given by the Women's Local Government Society, last night, and was much amused and edified. The speeches were most of them excellent, but rather too long, except Mrs. Fawcett's. Mrs. Hancock went too, and we sat together. To-day I have to go to a meeting of the Bedford College Women's Begging Committee (that is not its official title) of which they are going to make me Chairman. Mr. Acland came and asked me if I would serve, so I consented on condition that I was not expected to write any letters. Now I am sorry I did, because I seem to get less and less time for my own work—and yet I want to do it, because I would like to know more of the thinking and working women again, from whom I have been cut off for years. So I'm like a shuttlecock, with my own work and this sort of public work for the two battledores! Have you seen in the newspapers that M. and Mme Curie share with M. Becquerel the Nobel prize this year? I am so glad; I never thought it would come so soon. Only I would have liked Mme Curie to have it alone! . . .

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"December 16, 1903.—I went to the Bedford College meeting yesterday and was duly elected Chairman with flattering applause. Then Mr. Acland and Mrs. Bertie Russell and I retired to Miss Hurlbatt's room and had a private confab, and pretty well threshed out what the duties of Chairman and Secretary were to be. I think I am principally to hold back impetuous beggars from injuring their own cause! . . . We have not done badly to begin with, for after the first meeting Lady Tate walked up to Mr. Acland and coolly offered him £10,000 at once. We also nominated a Press Committee with Beatrice Harraden at the head. . . . We have just got the last *To-Day*, with Israel's article on Barrie's plays in it. I like it very much indeed—best of all, I think. . . . 'Mary Ann' is evidently going to be a very grateful child and bring a fortune to her father. I am so glad, because it means that he will be able to give himself to his work without any *arrière pensée* about ways and means. . . . Every one says how much better Father looks, but he is beginning to get restless again, and I shall be glad to get him to Highmead."

But her most serious preoccupation, that winter and during the following spring, was the preparation of her paper on "The Origin and Growth of Ripple-mark," which she read before the Royal Society on June 16, 1904.

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CHAPTER XIII

SAND RIPPLES AND THE HUGHES MEDAL (1904–6)

Hertha Ayrton's paper on sand ripples[1] was read by her in person, on June 16, 1904, and was, so far as can be ascertained, the first paper actually read by a woman before the Royal Society. It was accompanied by experiments with sand and water in glass troughs which were quite excusably described in one newspaper account as pretty, and which roused the admiration even of those who were inclined to be sceptical about the conclusions drawn from them. Mrs. Ayrton showed these experiments again, a fortnight later, at the ladies' conversazione of the Royal Society; and she read a similar paper, with additions and amplifications, to the Engineering section of the British Association, who met at Cambridge in August of the same year. These two papers formed the nucleus of a more popular lecture that she gave in the Albert Hall, Sheffield, on March 10, 1905, under the auspices of the Sheffield Literary and Philosophical Society. In each case, the accompanying experiments were shown in glass troughs of varying size, in which sand was deposited and covered with water; these troughs, placed on rollers, were set in motion to imitate the action of the waves

[1] "The Origin and Growth of Ripple Mark," by Hertha Ayrton (*Proceedings of the Royal Society*, A, Vol. 84, 1910). The publication of this paper was postponed until 1910 by the author's own wish.

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—the largest of them was worked by an electro-motor—and rapidly produced sand ripples and miniature sand-banks before the eyes of the audience, varying in formation according to the depth of water and sand, and the length of the wave produced in the trough.

This group of papers and lectures may be said to have embodied the conclusions arrived at in the first stage of Hertha Ayrton's researches into the formation of sand ripples and vortices in water. For the sake of clearness it seems advisable to anticipate a little at this point, and to explain that the effect of her researches, embodied in these early papers and in successive papers read by her before the Royal Society in 1908, 1910, 1911 and 1915, was to establish certain new facts about wave-motion which, she found, could be applied to other phenomena than sand ripples, of widely different origin. The valuable discoveries she made with regard to the vortices operating in oscillating water were, in fact, found by her to be applicable to the vortices in air; and—to anticipate still further—it was her application to similar phenomena in the air of the knowledge she had gained through her experiments with sand and water that inspired her to invent the "Ayrton fan," or flapper, during the Great War, a contrivance which, if vibrated in a certain way, could be used to clear the air of noxious gases and to substitute in their stead currents of fresh air.

Before the Royal Society in 1904, Mrs. Ayrton began by reminding her audience that Mr. Arthur Hunt the geologist had observed, as far back as 1882, that sand ripples are not formed, as popularly supposed, by the edges of the waves where they break on the shore, but are always formed under stationary waves (i.e. waves that are not breaking) that flow steadily to and fro over sand. About the same date, twenty-two

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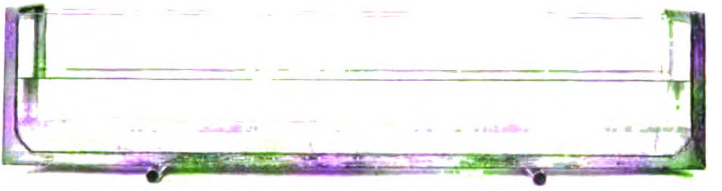
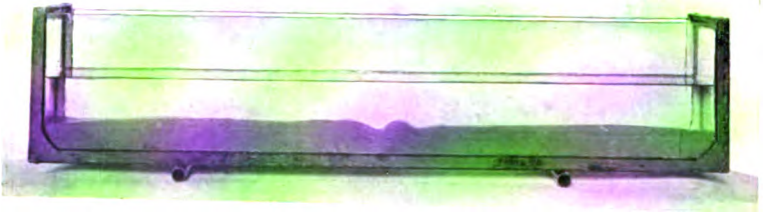
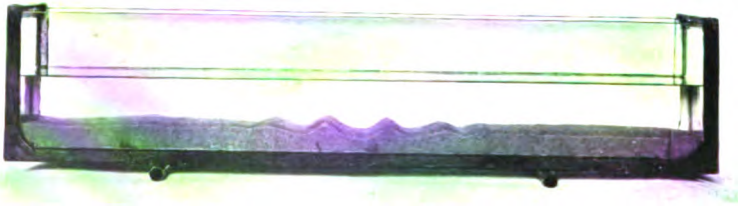


SAND IN TANK BEFORE OSCILLATION



FORMATION OF PRIMARY SAND RIPPLE



RESULT OF CONTINUED OSCILLATION

MRS. AYRTON'S EXPERIMENTAL TANK SHOWING THE FORMATION OF SAND RIPPLES

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years back, Professor George Darwin had further observed that certain vortices he saw in oscillating water over sand ripples helped to build the ripples higher; but he left the problem of the origin of the ripples practically untouched, assuming that each ripple was formed individually by friction only, that is, by the movement of the waves over some casual irregularity in the sand.

Mrs. Ayrton's first observations at Margate soon led her to reject Professor Darwin's assumption, since it did not seem to her to account for the absolute regularity of the ripples even in their earliest stages. She ultimately discovered, by experimenting with sand and water in small and large vessels, from a soap-dish to a tank, the existence of ripple-forming vortices (distinct from those observed by Professor Darwin) which always appeared on either side of an irregularity occurring in the sand under stationary waves. These ripple-forming vortices, she observed, began by causing the first irregularity to grow into a sand ridge with a hollow on each side of it (i.e. a sand ripple), and then proceeded to originate two fresh sand ripples, one on each side of the primary one; similar vortices then came into operation on the lee of these fresh ridges of sand, which in their turn produced two more sand ripples, and so on, until the entire surface of the sand would be ripple-marked. In other words, it needed but one single irregularity in a smooth expanse of sand to produce sand ripples all over it at perfectly regular intervals, provided always that waves were oscillating to and fro above it, and not breaking on the shore.

This growth of regular sand ripples was illustrated in the glass trough, where, in the smooth sand at the bottom of the water, Mrs. Ayrton made in alternate

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experiments a slight ridge and a slight depression in the sand; the trough was then rolled backwards and forwards and, in each case, sand ripples formed in twos as described by the lecturer. To prove that the vortices on the lee of the original ridge, and no fresh irregularities, created the subsequent ridges, a V-shaped depression was made in the sand, after which the primary and subsequent ridges were all seen to be V-shaped. The lecturer then threw some moist black pepper into the water (at this stage of her investigations, ground black pepper was the best substance she had discovered for her purpose, being of slightly greater specific gravity than water: later, she used aluminium powder and other substances); and, as soon as the water was set oscillating, the ripple vortices became plainly visible to the audience, their shape—a spiral ribbon of water, like a watch-spring in appearance—being defined by the black pepper. It was seen that these vortices appeared, first on one side and then on the other of the primary ridge of sand, sweeping the sand into hollows and then building it up into further ripples beyond, until all the sand in the trough became ripple-marked, the ripples in every case following the shape of the original irregularity.

The origin of the ripple-forming vortices was then inquired into. By further experiments with black pepper thrown into oscillating water, Mrs. Ayrton showed that the vortices always occurred in the second half of each swing of the wave; that is, not when the water, having risen high in its swing, was *falling* from the crest of the wave to the average level, but when the water was *rising* from the average level up to the crest of the wave and was therefore pressing against the general flow of the sea. This discovery explained why sand ripples are not formed by a current flowing in one

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direction—as in rivers—over smooth sand, because, in the absence of the necessary pressure exerted from the opposite direction (as seen in the case of stationary waves), the necessary ripple-forming vortices do not come into play, whatever irregularities in the sand may happen to occur.

In the case of the incoming tide on the sea shore, where the waves are setting in one direction, the lecturer was careful to point out that the shore slopes upwards and so provides the necessary pressure against the waves. When the tide goes out again, the edges of the retreating waves wash out the ripples as it recedes; that is why the shore above low-water mark is not covered with ripples, these remaining only in pools of water from which water drains away slowly.

Mrs. Ayrton's next experiment showed that groups of sand ripples differing from those formed on the sea shore, which originate in a primary irregularity of the sand, may be formed without the aid of any obvious irregularity farther out at sea, though not below a certain depth, simply by the action of stationary waves swinging to and fro over the same spot. In such cases, as she showed by a steady oscillation of the water in her largest trough over an undisturbed layer of sand, groups of sand ripples tend to form with smooth spaces between, which, if the oscillation is prolonged, then become heaped up into regular mounds of ripple-marked sand, two of these mounds being formed to each wave-length. The width of the smooth spaces and the height of the mounds depend upon the length of the waves and the depth of sand and water; but in every case she found, and showed in her experiments, that the mounds occurred where the level of water was most constant, that is *between* the crests of the waves, the smooth intervals occurring *beneath* the crest of the wave.

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A previous investigator, Monsieur C. Candolle, had observed the presence of these groups of sand ripples under stationary waves with smooth spaces between. "He appears, however," added Mrs. Ayrton, recording this fact in her Royal Society paper, "to have failed to notice the most important part about these groups of ripples, namely, that they finally grew into mounds, nor do I think that this fact has ever been previously mentioned."

Her preliminary experiments with sand and water, extending over the years 1901–5, led her therefore to three definite conclusions: (1) That sand ripples on the sea shore are not formed separately by waves flowing in each case over a chance irregularity in the otherwise smooth sand, but that, given one such irregularity, the vortices then set up by the water flowing over the irregularity will build regular sand ripples on either side of the primary ridge; (2) that these ripple-forming vortices always occur when the water in a stationary wave is rising, so that sand ripples of this type are never formed by a non-oscillating current of water setting steadily in one direction, as in rivers; and (3) that, without any obvious irregularity in the sand, stationary waves flowing constantly to and fro over the same spot cause the formation of certain groups of sand ripples with smooth intervals; that there are two of these groups to each wave-length; and that the continued oscillation pushes the ripple-marked sand eventually into two mounds, the mounds occurring *between* the crests of the waves, where the level of water is most constant, the smooth interval being always *under* the crest of the wave.

The third of the conclusions that she set out to establish by her experiments attracted most attention at the time and seemed to offer the most likely opening

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for further research. At the end of her Royal Society paper, she said:

"Besides tidal ridges, it seems probable that the chains of sand-banks in the sea and of sand-dunes on shore, as well as the gigantic sand-heaps in the Asiatic deserts described by Sven Hedin, originate and grow under the action of waves that are stationary for longer or shorter periods, while the smaller ripples that cover all of them are due to vortices similar to those that I have shown to produce the ripple mark of the sea shore."

At the meeting of the British Association in Cambridge, where she was addressing engineers, she threw out the interesting suggestion (which she repeated in the following spring at Sheffield) borne out by her observations at Kingsdown, near Deal, in the summer of 1903, that the Goodwin Sands have been originated by the action of stationary waves flowing constantly over smooth sand. She asked:

"Is it altogether beyond the bounds of engineering science, which this section so successfully cultivates, to imagine some way of altering the trend of the sea, so as to keep it from forming the stationary waves which, I believe, heap up the dangerous Goodwin Sands?"

The photographs of the sands and hollows of the Goodwin Sands, that were thrown upon the screen both at Cambridge and at Sheffield, certainly supported her contention by their remarkable similarity in appearance to those formed in miniature in her glass trough after steady oscillation over smooth sand. In a popular article written much later in the *Pall Mall Gazette* (January 24, 1921), Mrs. Ayrton reverted to this topic, and incidentally gave a brief summary of the general effect of her researches on sand ripples and vortices, which helps to make them intelligible to the unscientific reader:

"As yet, even as pure science, we have hardly touched upon the fringe of the subject, and when applied science takes up the

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principle I am confident that big practical results will follow. The Goodwin Sands are, I think, simply a series of mounds formed under the action of stationary waves to which the currents in these regions happen to give rise. The blowing up of some submerged rock, or anything that would change the course of any one of those currents, might cause the Goodwin Sands to disappear like magic. Again, coast erosion, so important in these islands, and air pockets, so dreaded by airmen, are, I believe, governed by the same laws as those which lead to the formation of the vortices that give rise to ripples."

It is possible that, had not Hertha Ayrton's mind been diverted from this line of research when she first indicated it in 1904–5, she would not have had to speak of it as still unexplored sixteen years later. But circumstances, both scientific and political, were destined so to distract her, and she never did more than throw it out as a possible solution of the problem of the Goodwin Sands. What interests us here is rather the fact, so characteristic of her, that the first practical application that occurred to her mind of the discoveries she had made took the form of a suggestion for the saving of life.

Considerable interest was also roused by her references to the very different effects produced by non-oscillating water that flowed in one direction over sand, as in the case of rivers. Sir Benjamin Baker, who particularly appreciated this part of her lecture, told her that a knowledge of the effect of rivers on sand would be of considerable value to engineers engaged in the work of bridging and diverting rivers, especially in India, where sand gave much trouble. "There is still a great deal of work to be done on this aspect of the subject," Mrs. Ayrton told an interviewer in Sheffield; "information as to the effect of water flowing in one direction over sand would help to show how river channels can be maintained against the silting-up process which so often presents difficulties."

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In the autumn of 1905, an electrical exhibition was held at Olympia at which Mrs. Ayrton gave a lecture on electric arc lighting. This year, too, in her capacity as a member of the Council of Bedford College, London, she took part in various functions of the college, notably a reception given in July to welcome the foreign students attending the holiday lectures arranged by the University of London. It was in the course of a speech she made at Bedford College, about this time, that an interesting allusion occurs to the continued refusal of the two older Universities to give degrees to women. "I wish I had a million of money!" she exclaimed, and went on to say:

"J. R. Green, the historian, once wrote a delightful little essay called the *Poetry of Wealth*. In it he described all the wonderful things that might be done by a man possessed of imagination and money at the same time—a rare, almost unique combination. . . . We have all heard of the American millionaires who endow universities and colleges; one lady alone has, I believe, given six millions sterling to one university in her lifetime. Oxford and Cambridge are both looking for such a benefactor; they have issued appeals lately for funds which meet with but scant response. Well, I should present my million to my *alma mater*—or perhaps I should say my *alma "step"-mater*—Cambridge, on condition that she opened her degrees to women on the same terms as to men. . . . But why do I dwell on the churlishness of two universities when all the others are open to us? Perhaps because a toothache is sufficient to make us forget that all the rest of our body is free from pain. We have much to be thankful for, but till our sex has ceased to be made an excuse for placing us at a disadvantage in any single respect, we shall continue to be daughters of the horse-leech and cry 'Give, give!'" [1]

Professor Ayrton's increasing ill-health once more broke into his wife's scientific work in 1906, causing them

[1] Fortunately, Mrs. Ayrton lived to see both the older Universities remove this disability of women, though her *alma "step"-mater* did so with reservations that still leave Cambridge women graduates short of complete equality with men graduates. (See p. 86—Note.)

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to spend a good deal of time out of town at their country cottage, Highmead, Little Baddow. From there, one week-end in April, Mrs. Ayrton wrote a characteristic letter to Barbie, who was spending her Easter holidays in Devonshire:

"DEAREST,—We have just arrived and had tea, and it is all exquisite. There is bright sunshine, and the hedges are just bursting into leaf and the roses on the verandah are in full leaf, so you see we are not so behind Devonshire! . . . The Crookes's party was a very brilliant one last night. Father did not go, he was too tired . . . it was so crowded that I saw lots of people in the distance whom I never got close enough to speak to. Professor Perry was there with Mrs. Stower, Alice having such a swollen face that she could not come. Of course all the Crookes children were there with their wives, the Johnstone Stoneys, Professor Tilden and dozens of others that we know. Somebody said to me—'You must feel just as if it were your own party, you know so many of the people.' Lady Crookes looked extremely nice in a white brocade with faint pink roses over it—very pretty. I had rather an exciting day, because the photographer, who was to have taken photos of my experiments for my Royal Society paper, telegraphed at the last moment that he was too ill to come. So I rushed off and bore back Nelly in triumph to do them. Many were instantaneous, and she did those with a Kodak; but two were mounds, and those she did with her larger camera. It was awfully good of her to come; she was just going out with Cécile, and I carried her off like a whirlwind. . . . I am glad you are having such a good time, my darling. The great thing is to enjoy life! Much love from your most affectionate MOTHER."

The spring of 1906 was marked by the tragic death of Professor Curie, who was run over in the streets of Paris, in May. This came naturally as a great shock to the Ayrtons among other English friends, though no one was more ready than Hertha to rejoice at the prompt and complete recognition of Madame Curie's scientific position that followed when Paris University appointed her to succeed her husband as Professor of General Physics at the Sorbonne. The news of her

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appointment was hailed in this country as another evidence of the advance of women in science, and most of the Press notices of it coupled her name with Hertha Ayrton's from this point of view.

The insomnia from which Professor Ayrton suffered culminated in a serious illness in the summer of the same year, and most of his wife's time and energies were devoted to nursing him through it. The birth of a grandson, Ayrton Zangwill, in the month of August, brought much happiness to the whole family and contributed to the Professor's recovery; but this was hastened very much more by the honour which was conferred upon his wife, when, on November 1, 1906, she received the following announcement from Professor Larmor, then Secretary of the Royal Society:

"MADAM,—I have the pleasure to inform you that the President and Council of the Royal Society have awarded to you the Hughes medal for your experimental investigations on the electric arc, and also upon sand ripples. It is hoped that you may be able to attend the Anniversary Meeting of the Society (November 30, at 4 p.m.) to receive the medal in person. I am, Madam, Your faithful servant, J. LARMOR (Secretary, R.S.)."

The Press, as well as the large number of friends who hastened to congratulate her on this distinction, made much of the fact that Hertha Ayrton was the first woman to become a medallist of the Royal Society exclusively on her own merits. Madame Curie, it was true, was a joint-recipient of the Davy medal of the Royal Society; but this had been presented to her in conjunction with her husband, for their combined work on radium. At that time, when woman suffrage was fast becoming an urgent question, and when, in spite of much progress made, many disabilities of women still remained, it was perhaps natural that any achievement by a woman should be judged in its relation to the general advance

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of women, somewhat to the exclusion of the special claims of the woman in question. Thus, in the case of Hertha Ayrton, so much insistence was laid upon the fact that the Royal Society had done something to raise the whole status of women in the country as to tend to obscure the intrinsic value of the award to Hertha Ayrton, the scientist. The Hughes medal, always bestowed like the other three Royal Society medals for original research work only, was in itself a refutation of the view that her scientific reputation depended upon the collaboration of her husband. To be a gold medallist of the Royal Society was in reality a higher honour, because more rare, than to be a Fellow of it; and more significant than the fact that she was the Society's first woman medallist (in her own right) was the fact that she was the first British gold medallist of the Royal Society who, if not already a Fellow, was not created one on being awarded one of the Society's medals. The accident of sex deprived her of the Fellowship; but her independent scientific research work brought her the Hughes medal, as it would have brought it to a man of similar attainments. She won it fairly as Hertha Ayrton, not as Mrs. W. E. Ayrton.

As a true suffragist, she always took the line herself that there should be no sex-differentiation in any of the professions. Long afterwards, in an interview published in the *Daily News* (July 16, 1919), she is reported to have said—and all who knew her would agree that the remarks are highly characteristic—

"Personally I do not agree with sex being brought into science at all. The idea of 'women and science' is entirely irrelevant. Either a woman is a good scientist, or she is not; in any case she should be given opportunities, and her work should be studied from the scientific, not the sex, point of view."

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She would have been the last person, however, to decline to share her triumph, for what it was worth, with the whole woman's movement; and she was probably glad, as well as a little amused, to read the following admission, apropos of the award, in *The Times* Engineering Supplement, to which she had contributed an article on electric arc carbons:

"Our countrymen have been slow to realize that women possess brains; we are too apt to regard them as the mere helpmeets of men. . . . It seems that the time has now come when woman should be permitted to take her place in the ranks of all our learned bodies."

And the following note in the popular weekly journal of that time, *M.A.P.* (November 17, 1906), suggests the same idea, together with an early allusion to "suffragettes" as such:

"Mrs. Ayrton is following in the steps of her clever French sister, Madame Curie. Her wonderful success in science is another feather in the cap of the suffragettes and should do much to obtain for them, even from the most biassed, a fair hearing; for it is women of the stamp of Mrs. Ayrton who are going to secure the complete franchise and emancipation of womankind."

Although the complete franchise and emancipation of womankind was not going to follow automatically for any reason so logical as the fitness of women to be enfranchised, there was, of course, some excuse for those who believed in the reasonableness of their cause to rejoice when a woman was acknowledged to be on an equality with men, in so strong a masculine preserve as the realm of pure science. Many of her suffragist correspondents congratulated her from this standpoint, beginning with her son-in-law, Israel Zangwill, who wrote as follows:

"Dear Mrs. Ayrton,—I feel that although Edie has conveyed my congratulations I must send you a personal line upon the splendid precedent you are setting up. . . . I hope that the next victory

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will be your becoming a Fellow, for the attempt to make a sex in science is even more ridiculous than in politics. I believe both these causes will be won before very long, and I am not indisposed to take advantage of easy opportunities for furthering them. I am sorry to say that most of what has been written on the subject by its friends is so stupid in one way or another that I seem to be not unnecessary. I am glad to hear that the Professor makes progress, or at least does not go backwards. With love to all the household, ISRAEL."

"We are proud to be the friends of such a woman," Mrs. Scharlieb, M.D., wrote to her. Miss Ethel Sargant, F.L.S., hoped in her letter of congratulation that "the approbation of their colleagues for women specialists must at last filter down to the public and alter the general attitude towards woman"; while Alys Russell (Mrs. Bertrand Russell) called Mrs. Ayrton's triumph, more racily, "a real leg-up for the cause!" There were natural rejoicings at Girton, where, according to the letter received by her from the Mistress, Miss Jones, the award was taken as one conferred also upon "the college and the cause of women generally." Letters poured in, too, from her relatives, Aunt Marion (Mrs. Hartog) writing: "It was good of you to write and tell me at once; I am proud of your success, and prouder of your love." Her cousins wrote in similar terms to send her their pleased congratulations.

But, pleasant as it was to receive so much evidence of affection and admiration from intimate friends, and to be hailed by distinguished acquaintances and strangers as having set up a landmark in the history of woman's development, the congratulations of her scientific colleagues must have been in an important sense the most highly valued of all that she received. The President of the Royal Society, Lord Rayleigh, may be taken to have expressed the opinion of the scientific world in the words with which he presented the Hughes medal to her on November 30, 1906:

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"Mrs. W. E. Ayrton is the recipient of the Hughes medal, which is awarded for original discovery in Physical Sciences, particularly electricity and magnetism or their applications. Her work on the electric arc has been described in a paper published in the philosophical transactions and in various other publications. Mrs. Ayrton's investigations cover a wide area. She discovered the laws connecting the potential difference between the carbons of an arc with the current and with the distance between them, and proved these to apply not only to her own experimental results, but to all the published results of previous observers. Dealing with the modifications introduced into the arc by the use of cores in the carbons, she found the causes of those modifications. The peculiar distribution of potential through the arc was traced and its laws were discovered by her. Having found the conditions necessary for maintaining a steady arc, and for using the power supplied to it most efficiently, she was able to explain the cause of 'hissing' and the causes of certain anomalies in the lighting power of the arc. For the past four years Mrs. Ayrton has been engaged in investigating the causes of the formation of sand ripples on the sea shore."

Among the first of her scientific friends to write and congratulate her was the astronomer, Lady Huggins, who said:

"I lose not a moment in warmly congratulating you upon the award of the Hughes medal by the Royal Society. You have worked both hard and well, and deserve reward—though I am sure you have never worked *for* reward. I deeply sympathize with the gratification you have the right to feel; and I truly rejoice in the encouragement and heartening which this success must be to you."

Lady Crookes wrote on behalf of herself and Sir William, to congratulate her on the award "in recognition of your long and useful work in the cause of science," and to hope that "it is only the first of a series of triumphs for you after so many years of neglect."

Mr. Maurice Solomon[1] added to his felicitations the

[1] One of Professor Ayrton's pupils, who had made the index for Hertha Ayrton's book, *The Electric Arc*. His little half-brother, "Billy," was a playmate in early youth of Barbara Ayrton Gould.

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assurance that "the award will be welcomed by no one with greater satisfaction than by those who have had both the honour and pleasure to be associated with you, in however humble a capacity, in some of your work." Another scientific friend, also a pupil of her husband's, Mr. Rollo Appleyard, wrote as follows:

"Your good work has literally left 'footprints in the sands of time,' and it will give many men, and what is of more importance, many women, courage to take heart again, to improve general knowledge and their own lives by looking into what is. Although many of us who have followed your work are quite clear as to its originality and distinctness from Professor Ayrton's, we are conscious of the happiness he must feel at this moment, and we desire to congratulate him too."

This letter is endorsed by one that Mrs. Ayrton wrote (November 2, 1906) to Mrs. Herbert Mills, who, after her mother's death and before her marriage to Dr. Mills, had regarded Hertha as a sort of guardian and lived for a time with the Ayrtons at Kensington Park Gardens. The letter is one of congratulation to Mrs. Mills for having won a gold medal for enamel work at Milan Exhibition; and in the course of it Mrs. Ayrton writes:

"I think the Professor has told you that I have a gold medal too—from the Royal Society. I have had the most charming letter from Lady Huggins, sent off the moment she heard. It is particularly generous of her, because she has done some splendid work in astronomy herself, with her husband, and has not had a bit of recognition for it just because no one will believe that if a man and a woman do a bit of work together the woman really does anything.[1] That's where the Professor has always been so generous.

[1] Mrs. Ayrton was among those to rejoice, therefore, when the Royal Astronomical Society secured its supplemental Charter in 1915, and by asking Lady Huggins at once to become a Fellow, recognized her own individual achievements. It must be added, however, that they had already to some extent done so by electing her an honorary member of their Society as far back as 1903.

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He has never joined with me in any bit of work just because he knew it would all be ascribed to him, and he wanted me to get the full kudos for all I did, not only for my own sake, but for the sake of all women."

Certainly, among all who congratulated her on her distinction, none was more enthusiastic than Hertha Ayrton's husband. In a letter to Edie Zangwill, dated November 18, 1906, Mrs. Ayrton writes:

"Father has been wonderfully better the last ten days, partly, I think, because he is so interested and amused at all the Press notices, requests for articles and interviews, etc., that I am getting. Every day there is something, and that keeps up a little pleasurable excitement. . . . Anyway, he is more like his old self than he has been since the beginning of the year."

This would not have surprised anyone who knew the terms of equality on which the Ayrtons lived and worked. Those who jump to the easy conclusion that without the Professor's help and influence Hertha Ayrton's scientific achievements would have been held of no importance often omit to notice the greatest contribution he really made towards her success—the unfailing encouragement he gave her all through their married life to develop her abilities to the utmost, as well as his determination that she should keep her scientific work distinct from his, except of course on the few occasions when she was assisting him in his experiments. To her cousin, Dr. Philip Hartog, he once went so far as to say: "You and I are able people, but Hertha is a genius; I have come to realize this more and more." All Professor Ayrton's help in facilitating his wife's entry into the world of science, and naturally his position enabled him to give her such help, was subordinated to his desire that her own distinct reputation for original research should remain secure and unassailable. Now, in 1906, he had his reward; for, equally

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but not jointly honoured by the Royal Society, recognized by that body as distinct individuals, they stood for a union in which similarity of taste and capacity did not mean identity of achievement, nor mutual sympathy involve loss of personality.

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CHAPTER XIV

THE SUFFRAGIST INTRUSION (1906–8)

Further work on the electric arc, as well as continuous experiments on the vortices in water, absorbed much of Mrs. Ayrton's attention for the next few years. Owing to the state of her husband's health, it was left to her to conduct the major part of the investigations involved in the drawing up of four reports on searchlight carbons which the Admiralty had commissioned Professor Ayrton to make. An account of these investigations, to which the high standard of British searchlights during the war may be largely attributed, must be deferred, however, to the next chapter. The year 1906, when the Hughes medal was conferred upon her, was a momentous one in Hertha Ayrton's life, and not only from a scientific point of view. It also marked her entry into politics; and her frank support of militant suffrage influenced her life to so high a degree that it becomes necessary here to say something about her connection with the organization known as the Women's Social and Political Union.

Hertha Ayrton had always been a suffragist as a matter of course. As her early letters show, she never required any conversion to the principle of votes for women; and in the course of an address given by her in November, 1909, to Bedford College students, she incidentally revealed the kind of soil upon which seeds sown by her elders in her childhood had inevitably

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fallen. Referring in her speech to the story of Vashti in the Book of Esther, and calling her "the first woman with the spirit of the suffragette in her," she went on to say:

"When I was a little girl, being a Jewess, I had to read that story through every year, and I well remember to this day the indignation that used to surge up in me at the treatment of Vashti, and especially at the subsequent proclamation of Ahasuerus. That story made me a suffragette at a very early age, though all unconsciously to my pastors and masters, who imagined it was producing a very different effect—and perhaps too to myself."

She was one of those people who are born with a passion for justice; and if anything could have upset the balanced judgment which as a scientist she naturally exercised in ordinary matters, it would have been the discovery of some injustice done to another. If she had never heard of the organized suffrage movement, the abstract injustice implied in the denial of votes to women would have been certain to reveal to her, sooner or later, that she had been a suffragist all her life without knowing it. As it happened, however, she had never been allowed to remain in ignorance of the movement. From early days, all her friends had been suffragists. Among her contemporaries Mrs. Hancock was one of the most active workers in the cause, though as a Liberal she never approved the anti-Government policy of the W.S.P.U. (which, the Liberals being in power throughout the militant campaign, happened to be directed only against her particular party), and she also deprecated what seemed to her the manifestation of a sex war. Their difference of opinion about militant tactics may be said to have caused the only real misunderstanding that occurred in their long friendship. As Ottilie Blind, Mrs. Hancock had been the first to take Sarah Marks to suffrage meetings and

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had helped to enrol her, when she was only eighteen, a member of the Hampstead branch of the Central Society for Women's Suffrage. In addition, Hertha had associated during her Girton period [with the veterans of the suffrage agitation, both Madame Bodichon and Miss Emily Davies being pioneers in the political as well as the educational wing of the woman's movement. In later years, Mrs. Ayrton gave some account of her earlier suffrage memories in a newspaper interview, which appeared in the *Daily Province* (Vancouver) on December 8, 1913:

"Girton College had only about twenty-five students when I entered it, and about fifty when I left. Perhaps half-a-dozen of them were suffragists, and that was a far greater proportion than one could meet with in any other circle which was not of that academic character. . . . To be a woman suffragist in those days was to be regarded as eccentric. Now, practically every Girton or Newnham girl is pledged to the cause. . . . Madame Bodichon, who made the college course possible for me, and Miss Emily Davies, were among the pioneers of the woman suffrage movement in England. They were both in the little committee which met in 1866 at the home of Miss Garrett, afterwards Dr. Garrett Anderson . . . to promote a petition that was to be presented to Parliament in connection with the woman suffrage agitation started by John Stuart Mill. . . . "

Until militant tactics ushered in the new phase of the suffrage movement, Mrs. Ayrton had not felt called upon to make any active sacrifices for it, thinking that she could further it better by showing in her personal achievement women's general fitness for the vote; she had therefore concentrated on scientific work and done little more for the political campaign than attend meetings and lend it the support of her name. She was a vice-president of the National Union of Women's Suffrage Societies, which represented the organized suffrage movement in England, and she was actually

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attending a suffrage congress at Hull in October, 1905, when the newspapers reported that two young girls—Christabel Pankhurst, a law student, and Annie Kenney, a mill girl—had been thrown out of Sir Edward Grey's meeting at Manchester for raising the question of Government responsibility for the Suffrage Bill and refusing to sit down until their question had been answered, and had been subsequently imprisoned for attempting to address the crowd that assembled in the street outside.

At the time, as she confessed afterwards, Mrs. Ayrton missed the point of their protest, which was very insufficiently, and in some cases inaccurately, reported. But when, in the following spring, a demonstration was made in the Ladies' Gallery of the House of Commons by members of the same suffrage society, who were provoked into protest by the apparent intention of the House again to talk out the women's Bill, intellectual honesty, as well as her sense of the value of evidence, led her to make careful inquiries into the origin of these tactics. Again in her own words, we can read how she came to attach herself, as a result of her inquiries, to the militant suffrage organization:

"I heard more and more of the activities of the new society, and began to realize that it was arousing an interest in the movement such as had never been felt in it before. So when in the summer (1906) I received a circular inviting me to attend a meeting in Clement's Inn, the headquarters of the Women's Social and Political Union, I decided to go, for I felt it was time to welcome the new effort.

"The Union occupied only two rooms then. There were about twenty-five persons present at the meeting. The speakers stood up on a box at the end of the room. One of the speakers was an old lady with white hair, who was Mrs. Despard, one of the old workers in the cause. She was followed by a beautiful young girl who did not appear to be more than twenty years old, but who in her short speech impressed me profoundly with her clear judgment

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and her keen political insight. It was Christabel Pankhurst. My daughter, who was with me, and who was then a student at the University of London, at once decided to join the Union and to devote all her leisure to promoting its work."

To understand the full significance of her action in identifying herself with the "suffragettes," as the popular Press at once nicknamed the newer type of suffragist, it is necessary to realize both the contempt with which the militant pioneers were regarded by a public mainly misinformed as to their actions and intentions, and also Mrs. Ayrton's position in social and scientific circles. It was difficult for an obscure woman to acknowledge her sympathy with people who made riots in public places and went to prison as common criminals; but for anyone as well known as Mrs. Ayrton to do so was courageous to a high degree. To her it did not, of course, appear in that light, or in any way as an extraordinary thing to do. Like every other important step she took throughout life, this one was taken unhesitatingly, because it seemed to her the only thing to do. But the consequences to her were very considerable.

It was never her intention to give up scientific research in order to devote herself to the suffrage campaign; and indeed, all through the years of political effort that continued until women won the vote, she carried on her own work, often under great stress and difficulty, believing that this was still the greatest service she could render to the women's cause. Except for her participation in the militant demonstrations of 1910, her support of the W.S.P.U. took the perfectly constitutional form of generous contributions to the funds, hospitality to members of the Union (even when this involved unpleasant publicity, as on the many occasions when she sheltered Mrs. Pankhurst and other ex-

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prisoners who were shadowed by detectives), and above all, of a vigorous championship of their methods at all times and seasons. It was her inability to keep silent when militancy was misrepresented or condemned in her presence that, I think, contributed more than anything else to the disapproval that she roused among her acquaintances, especially those who knew her best as a physicist. Others might hold similar opinions and yet manage to evade the hostility that she almost seemed to court, by her vigorous defence of people who were very generally considered to have placed themselves outside the pale of decent society. Certainly, she stooped to no diplomacy and wasted no tact in dealing with her opponents.

Those who, like the present writer, first made her personal acquaintance in the ranks of the militant suffragists, attached less value to the absence of tact and diplomacy than to the presence of a courage and unselfishness that made such a woman come forward in their support at this difficult moment. At the same time, one can perfectly understand that, to many who were lukewarm suffragists or definite opponents —and nearly every one in the particular circle in which she moved was one or the other—her championship of the less "respectable" section of the suffrage movement, when it did not appear merely incomprehensible, seemed to them suicidal from the standpoint of her career. And of course it is highly probable that if she had kept out of the political arena altogether and shut herself up in her laboratory, while other women worked for the suffrage cause, she would not have left so much uncompleted when she died, and her fame as a scientist might have been even more assured. Hertha Ayrton may in fact be called one instance of the wastage of woman's effort and woman's talent

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that went on for fifty years before statesmen recognized the inevitable in 1918. But history is full of such instances of wastage, and it is idle to speculate on what might have been. In her case, the only thing to remember is that, whatever view may be held as to the wisdom or expediency of the course she chose to follow, it could always be summed up in the famous affirmation—"Here stand I; I can no other." Her whole life had been a preparation for this crisis; there was no other conceivable way in which she could have met it when it arose.

There is no doubt that her democratic opinions helped to make her an ardent suffragist. "I was at the first general suffrage congress which was held in London," she observed in the course of the interview already referred to; and she went on to narrate an interesting anecdote about W. T. Stead:

"W. T. Stead was one of the speakers, and I well remember his words. He said, 'You'll never win the vote, you silken-petticoated women. You're all too damned comfortable. It will be the working women who will get it.' I have often thought of those words since the recent developments. He was not wholly right, for it is going to take the two classes together, the women of education and leisure and the wage-earning women, working side by side, to win this fight. And they are coming together now. The advent of militancy has brought about this condition. I consider that the first act of militancy, in which Christabel Pankhurst and Annie Kenney, representing these two classes of women, struck the first blow for freedom, was symbolical of this union of forces which will soon be victorious."

This feeling for common humanity as opposed to mere feminism probably kept Hertha Ayrton from adopting the attitude of that small minority among women reformers who sometimes seem to aim rather at the dominance of women than at the equality of the sexes. Mrs. Ayrton was never a suffragist with

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a grievance, and when asked on one occasion to speak particularly on the disabilities suffered by scientific women, replied that these did not differ sufficiently from the general disabilities of voteless women to demand separate treatment. She was also fully conscious that the existence of anti-suffragist women, "with their squaw sentiments," was one of the greatest obstacles to woman suffrage; and she observed of them, in one of her few suffrage speeches, that their touching faith in their own prophecies (of the disasters that would follow women's enfranchisement) justified the old definition of faith as "a belief in something that you know is not true." She reminded the same audience that "a fool is one who has never made an experiment." She was equally frank about women who were suffragists and yet failed to take full advantage of the opportunities that had already been won for them, and she urged them to enter the professions whenever it was possible for them to do so, particularly in the sphere of applied science.

Indeed, like many who are loosely classified as violent extremists, she was in reality a most sane and reasonable partisan; and her reputation for violent opinions was founded entirely, I believe, upon her readiness to show that she had the courage of her opinions, on occasions when others might have remained silent for fear of causing unpleasantness. With her sensitive nature, she disliked unpleasantness as much as anybody; but she would never have allowed the fear of it, or the fear of anything else, to make her deny the faith that was in her. I do not think that she ever realized the simple fact that a fearless expression of opinion often produces more detestation of the advocate, and at the same time louder accusations of violence, than real violence produces.

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Soon after that first meeting in Clement's Inn, Cobden's daughter, Mrs. Cobden-Sanderson, who as Annie Cobden had been in the Bodichon set and had known Hertha in her teaching days, also astonished her friends by joining the Women's Social and Political Union, and still more, by taking part with nine others in a militant demonstration in the Lobby of the House of Commons, which resulted in their being arrested in the precincts of the House on a technical charge of obstruction, and sentenced on the following day to two months' imprisonment. Hertha Ayrton, who was very much in the public eye just then as the recipient of the Hughes medal, wrote the following letter on November 6, 1906, to Mrs. Cobden-Sanderson, through whom it found its way into the newspapers:

"DEAR MRS. COBDEN-SANDERSON,—I feel I must write you one word of sympathy and admiration for the work you and your fellow-sufferers are doing in the cause of women. Every thinking woman must be supremely grateful to those who have been willing to sacrifice themselves so nobly for the purpose of drawing attention to the injustice under which we all smart but which comes with tenfold force on our poorer sisters. Of course we all know that the hysterical behaviour attributed to you was mere froth on the pen of penny-a-liners, but that you should have had the courage deliberately to put yourselves in the position to be so bespattered for a great purpose was splendid—a never-to-be-forgotten service that you have rendered to your sex. Please accept my admiration and my thanks. I feel sure that you have carried us an immense step further towards our goal. Very sincerely yours, HERTHA AYRTON."

One of the results of the demonstration in the Lobby was to cause the formation of a little committee of well-known women, headed by Mrs. Fawcett, the leader of the constitutional suffragists, for the purpose of organizing a public banquet of welcome to the imprisoned suffragettes upon their release from Holloway Gaol. Hertha Ayrton was a prominent member of

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this committee, and, but for an unfortunate attack of influenza which made it impossible for her to use her voice, though she was able to be present, she would have been one of the speakers at the dinner which was held in the Savoy Hotel on December 11, 1906. Her daughter Barbara was present with her; and her son-in-law, Israel Zangwill, was one of the two men who moved and seconded the vote of thanks to the chairman, Mrs. Fawcett, this being the first of Mr. Zangwill's many public utterances in support of woman suffrage.

When Mrs. Fawcett's society organized the first suffrage procession through London, in February, 1907—occurring on a wet day, it was always known afterwards as the "Mud March"—many of the militants walked in it; and Mrs. Ayrton was one of the marchers who attended the meeting in the old Exeter Hall, Strand, which was the objective of the procession. Here one of the principal speakers was Israel Zangwill, who rather astonished the law-abiding portion of his audience by a defence of their militant sisters. He spoke again in the same hall a month later (I think at the last public meeting held in it before its demolition), this time on the platform of the W.S.P.U.; and Mrs. Ayrton wrote to him afterwards with enthusiasm about his speech. "You were great; you were equal to yourself," she told him, and added her warm thanks for his advocacy of the women's cause.

It must have been a lasting source of comfort to her that, while many of her relatives and friends failed to sympathize with her keen championship of the militant suffragists, those who were nearest to her always felt as she did. Her daughter Barbara was an active militant from the earliest days of militancy, and Mrs. Zangwill, unable to give quite so much time, was equally ready on all possible occasions to speak

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and work for both branches of the movement. But Mrs. Ayrton's greatest ally, in the short time that remained to them of their married life, was her husband. Always consistent where the position of women was concerned, Professor Ayrton saw the meaning and importance of the militant development from the moment of its inception. He never swerved from his support of the W.S.P.U. nor from his loyalty to its leaders, for whom he felt great admiration. This support from a well-known and distinguished man was not only of incalculable value to the militant movement; to his wife it was the crowning-point of that sympathy and understanding which had always made their union both intellectually and humanly satisfying.

It was in the spring of 1907 that I made the personal acquaintance of Hertha Ayrton, at a suffrage meeting in a Kensington drawing-room. She was not one of the speakers—she never spoke except under extreme pressure, for she disliked public speaking almost as much as she disliked writing—but her enlightened attitude towards the whole question, a refreshing one in that rather reactionary neighbourhood, was revealed in the few moments of conversation we had together. Like others meeting her for the first time, I was at once arrested by her extraordinary vitality and freshness of mind. Here was some one you could not easily forget, some one you wanted keenly to meet again in order to find out what it was that made her so much alive and so stimulating. I did meet her again many times, for that was the beginning of a sixteen-years' friendship; but all that year and the next I saw very little of her, for she was much occupied with her work on electric arc carbons, and her husband's rapidly failing health kept her to a considerable extent out of public life.

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Now and then, a letter appeared over her signature in *The Times*, demolishing some anti-suffragist fallacy that seems to us hardly worth demolition as we read it with astonishment to-day; and one saw her occasionally at suffrage functions, but not often. "I had a visit from Miss Annie Kenney this morning," she writes to Barbie on January 2, 1907, "to ask me to take the chair at a breakfast to be given to-morrow to the latest of the released prisoners;—I refused and said that, even if Father were not ill, I could not give time to such things, as I thought I helped the cause more by doing my own work."

There were occasional relaxations, however, even in this very busy period, as, for instance, when a hundred old Girton girls entertained her at a luncheon in the Café Monico, in April 1907. Miss K. Jex-Blake took the chair, and, proposing the health of the College, mentioned the foundation of new scholarships and other facilities for enabling Girton "graduates" to return to Cambridge for research work, a piece of information which would particularly appeal to the guest of the afternoon, whose own research work before marriage had been pursued under such difficulties. The issue of the *Labour Leader* that week, making a comparison between this luncheon party and an East End procession of the wives of unemployed men that coincided with it, asked whether "the fair girl graduates" had ever given "the grim problem of unemployment" a thought. One at least of the fair girl graduates could have answered their question with a clear conscience; for, to Hertha Ayrton, it was such problems as these that seemed to constitute the great urgency of the suffrage question.

On June 28, 1907, at the Central Technical College, Mrs. Ayrton gave a demonstration of her sand-ripple

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experiments before the Physical Society, Professor Ayrton taking the chair in one of his rare intervals of good health. Some additional interest attaches to this meeting from the circumstance that Hertha Marks, an unknown student, had made her first public appearance before the members of the Physical Society in 1885, when she lectured on her line-divider. In October of the same year, 1907, a scientific event of world-wide importance took place when the Marconi wireless service between England and America was opened; and among the messages of congratulation transmitted to the inventor was one from Mrs. Ayrton, in which she characteristically referred to the prejudice and incredulity that Mr. Marconi had encountered from scientific colleagues. Her message concluded with the words: "His quick insight into its practicability, and his determination to achieve what those who should best know believed to be impossibilities, deserved this magnificent success."

The discovery of the ripple-forming vortices in water had led her to make further investigations along the same lines, with the result that on January 30, 1908, she read her next paper before the Royal Society,[1] entitled the "Non-Periodic or Residual Motion of Water moving in Stationary Waves." The object of this paper was to show experimentally the exact movements of water particles in stationary waves, part of which had been traced out mathematically by Lord Rayleigh but not hitherto proved by experiment. By the use of glass troughs as before, in which she inserted bronze or aluminium powder and drops of water paint as required, she not only showed in actual working the vortices whose existence Lord Rayleigh had discovered by pure mathematics, but also carried the investigation further

[1] See *Proceedings of the Royal Society*, A, Vol. 80, 1908.

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than he did and further than she had done before. On this occasion, and also at the Ladies' Conversazione of the Royal Society, Mrs. Ayrton demonstrated that when a liquid rises and falls in rhythmical wave-motion, as in stationary waves, its particles do not simply move to and fro, returning like pendulums to their starting-points after each oscillation, but that each particle takes up a new position after each oscillation, so that it traces out a path for itself, only returning after many oscillations to the point from which it started. This general movement, which takes place in conjunction with the oscillatory or wave movement to and fro, she called the residual motion of the liquid; and it takes the form of vortices, which, as she was able to demonstrate in her tanks, look like spirals moving in opposite directions. She showed how there are two principal sets of vortices to each stationary half-wave, the end ones stretching from crest to trough and embracing the inner ones in the middle. Both the length and the height of the inner pair were shown to depend on the depth of the water, while the end pair grew as the others diminished until the water reached a depth of half a wave-length in its movement to and fro; the inner vortices then ceased to exist altogether, the whole of the half-wave being now occupied by two oblong residual vortices moving from crest to trough and from trough to crest.

This was the first set of her experiments that I happened to see. She showed them to me in her own laboratory, and her ingenuity in constructing the apparatus for making them convincing to the critics of the Royal Society gave one some idea of the mechanical ability, inherited, no doubt, from the watchmaker of Petworth, that she possessed in addition to her purely scientific qualities. No contrivance seemed too intricate

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or too minute for her fingers to manufacture or to manipulate; and it was typical of her that she set apart a drawer in her laboratory for storing odds and ends of every description, bits of cork, wire, glass and rubber tubing, scraps of stuff, old lids and spouts—a kind of glorified Jumble Sale or schoolboy's pocketful of rubbish, to which she would go when she wanted to prove the presence of a vortex in water, or to construct a model of an anti-gas fan no bigger than a postage stamp. That drawer in her laboratory helped one to understand both the original way she worked herself, and also the advice she had given to an audience of students at the Women's International Congress in 1899, when she told them not to read too much about the discoveries of other people before making their own experiments. "Only when you are longing to know the meaning of some particular set of phenomena that you have yourself observed should you turn to books to see if they can help you," she said. "The books will answer your questions, and you will then be able to assimilate them with an ease that is unattainable unless you have acquired some living knowledge of the subject beforehand."

In the spring of 1908, her own health showed signs of a breakdown, and she was prevailed upon, very reluctantly, to go away in March for a month's rest, an enforced holiday out of which she extracted a good deal of pleasure, for she spent it with the Zangwills in their home at East Preston, and was very happy there in the company of her grandchild, their son Ayrton. She was unable, consequently, to appear on the platform of the first Albert Hall meeting held by the Women's Social and Political Union, a disappointment that her husband fully appreciated in the letter he wrote her on March 20. In this he says:

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"I asked Miss Christabel not to answer my letter. But she knows I took all the blame on myself for your absence on Thursday evening, and even she—a strong strapping thing, and no doubt quite sure, as I was at her age, that while other people might get ill she never will—agrees with my prudence in trying to get you well yourself as your first duty in life. . . . Besides, who is to teach little Ayrton mathematics on the sea shore if you leave, and how can we hope he will be Senior Wrangler and Smith's Prizeman? Think of what you risk! A month will end, in more senses than one, on March 31st. . . . X—— pronounces that he does 'not approve of the action of the National Women's Social and Political Union.' It is really like Oscar Wilde being 'disappointed with the Atlantic,' so little do they, any of them, understand the working of great forces which requires a great mind to grasp, I am inclined to think! Bar has, no doubt, told you that she was everywhere on Thursday evening: in the Artists' Room, in the top gallery, etc., listening to the speeches and collecting money. Some gave 2*s.* 6*d.*, many £50, and one £1,000. The Atlantic billows are very large in big storms, in spite of Oscar Wilde's disappointment and the polite disapproval of those of small faith and mind."

Barbara, as has been already noted, joined the Women's Social and Political Union with her mother in the summer of 1906. She had left the Notting Hill High School, by that time, to become a student at University College; but she did not work for a degree, as she wished to take special subjects rather than submit to the limitations of the degree course. Having done very well in the Honours course in chemistry and physiology, which she took in 1907, she became a research student for a year; but her college career was a chequered one, not so much through the demands of the suffrage movement as on account of her father's illness and the continual strain this meant both to her mother and herself. The suffrage movement was only partially responsible for her decision to leave college at the end of the summer term, 1908, for the conditions of her home life would have made this desirable in any case.

All the summer and autumn of 1908, Professor

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Ayrton's state of health became increasingly serious. Except at the two conversaziones in London, Mrs. Ayrton made no public appearance that summer; and, as the weeks went on, she scarcely left her husband's side. A good deal of time was spent at Little Baddow, and their friends did not see much of them either then or later when they returned to Norfolk Square. Hertha Ayrton, as others besides the present writer have had occasion to experience, was a perfect nurse; and her deftness and ability, as well as those qualities of sympathy and tenderness that made her always such a human person, must have been invaluable in her husband's last and terribly trying illness, which was brought on by overwork and caused the patient incessant nervous suffering. That she unstintingly gave of her best, all through those strenuous months, to the man who had never failed her in affectionate understanding and admiring encouragement, need scarcely be said; nor is it necessary to speak here of the loss she sustained in his death. One who knew her very intimately has said that only those who met her before this date really saw the gaiety and merriment that made up so large a part of her temperament; she lost it through what she suffered, first at the time of her husband's illness and death, and later in the suffrage movement and the war. But no one who met her at any time of her life would question that the sacrifice was always willingly made, and that what she had to give was given unsparingly.

Professor W. E. Ayrton died on November 8, 1908; and his death closed a companionship which had never ceased to be an association of two minds equally distinguished and, in the noblest sense, mutually dependent. This is not the place to dwell upon Professor Ayrton's scientific eminence and achievements, to which the newspapers and serious journals of the day paid high

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tribute when his death was announced. But in view of the omission from nearly all these obituary notices of his faith in woman suffrage and his comprehension of the militant campaign, a passage from the account that appeared in *Votes for Women* (November 12, 1908), the official organ of the Women's Social and Political Union, may be appropriately quoted here:

"His appreciation of and practical sympathy with the work for woman suffrage was at all times freely demonstrated, and the loyal support and hearty encouragement which was his unfailing attitude towards the leaders of the W.S.P.U., whose personal friend he was, will be sadly missed by them. The world will be the poorer, the cause of humanity, with which the women's movement is indissolubly bound up, immeasurably the loser, by the death of the great and good man whose loss we deplore so sincerely and truly to-day."

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CHAPTER XV

MORE SCIENCE AND MORE SUFFRAGE (1904–10)

In the course of the year 1903 Professor Ayrton had been requested by the Admiralty to supply a specification for carbons that would burn satisfactorily in searchlight projectors, and to investigate generally the cause of the strange behaviour of the electric arc when a strong current was employed for a powerful beam of light, such as would naturally be required in searchlights. Those of us who can recall how erratically the electric arc used to behave in the earlier days of its use in street lighting can imagine the much graver disadvantages attending similar behaviour in the case of a searchlight, which was liable at any moment to roar in a deafening manner and then go out altogether, perhaps just at the moment when the enemy's torpedo-boat was coming into action. For some time, Professor Ayrton investigated the matter with his students and assistants at South Kensington. "Much time and labour, he has told me, were spent in his laboratories," says Mr. Stephen Hawes, M.I.E.E., the electrical engineer, in an article contributed by him to the *Daily Chronicle*, a few years later (July 17, 1908):

"All sorts of possible explanations of the cause of the troubles were investigated and a variety of means for removing them were employed by the Professor and his staff, only to be discarded one after another in succession. Finally, the Professor appealed to Mrs. Ayrton to solve the problem. To ascertain the cause of the refractory behaviour of the arc and to devise the remedy was a task that

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exactly suited Mrs. Ayrton. With her usual intuition she mastered this mysterious and hitherto unexplained scientific phenomenon and proved that the deafening roar of the searchlight was merely a gigantic magnification of the hiss of the much smaller arcs that are commonly used for street lighting. And just as, step by step, she unearthed the hitherto unknown cause of that hissing,[1] so she demonstrated how to stop the roaring and the erratic wanderings of the arc of a searchlight."

By this time Mrs. Ayrton was considered, Mr. Stephen Hawes mentions in his article, "the leading authority of the world on the electric arc"; but besides this very obvious motive for seeking her collaboration, Professor Ayrton possessed an additional reason in his health, which, after his more serious breakdown in 1905, made it impossible for him to do more than share spasmodically in the investigation that Mrs. Ayrton carried on to its completion. The four reports submitted to the Admiralty in the years 1904–8 were treated officially as his, although Mrs. Ayrton assisted greatly in drawing up the three earlier reports, and the fourth was actually sent in over her own name because it embodied her unaided researches, and Professor Ayrton insisted that this should be made clear when it was forwarded to the Admiralty. The official mind, however, seemed unable to grasp that the work was not really done by the man who had been commissioned to do it; and perhaps it is unreasonable to expect too much of the official mind. All that mattered was that the work was accomplished and the worst defects of our searchlights were removed, owing to the success of this investigation; and Hertha Ayrton could afford to smile—as she always did afterwards when telling the story—at the fact that the fee was sent to her husband, for he never made the least secret himself of its having been earned by his wife.

The chief discoveries recorded in these four reports

[1] See Chapters X and XI.

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relate to the relative sizes, shapes and positions of the two carbons, the positive and negative, which, placed horizontally with their ends pointing towards each other, together create the electric arc. As most people probably now know, a searchlight consists of the white-hot spot or crater of an electric arc, and a reflector or mirror which receives the light from the crater and sends it out past the arc as a beam or ray. In order to get a steady and good beam of light, the position of the white-hot spot or crater, about the size of a shilling, must be kept accurately fixed relative to the mirror, and the spot must be of uniform brightness.

The electric current travels from the positive carbon to the negative carbon across a bridge, as it were, of hot carbon vapour or flame; this bridge is the electric arc, of which (1) the crater or spot of light at the end of the positive carbon, and (2) the tip of the negative carbon, form the two ends of the arc, or the two supports of the imaginary bridge. As Hertha Ayrton established in the course of her earlier investigations on the arc, it is essential to a steady and bright light, free from hissing or roaring, that the spot of light (i.e. the crater of the arc) should not move about; and to keep it stationary in its position at the end of the positive carbon, the negative carbon opposite to it should maintain a definite small tip or projection. At the same time, the negative carbon has to be as small as possible so that it may not cast too large a shadow in the way of the arc and so block the beam of light on its way to the mirror.

It can thus be seen that it is essential for both carbons to burn at the same rate, and the reports sent in by Professor and Mrs. Ayrton are mainly directed towards attaining this end. They contain definite recommendations regarding the length of the carbons and their exact position in relation to each other, the length of the

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arc or bridge, and the size, composition and shaping of the carbons, besides certain suggestions for improving the lamp or projector of the searchlight. In respect to the shaping of the carbons, Mrs. Ayrton made one essential change that is to be classed with those important innovations that often seem ludicrously simple when somebody else thinks of them. The carbons had always hitherto been supplied to the Admiralty in the shape of uncut pencils, so that it was only in the course of burning that the tip of the negative carbon acquired the shape essential to a steady searchlight. This process occupied normally some twenty minutes; so that, when the carbons were burnt out and had to be replaced by new ones, twenty minutes might elapse before the light was again in working order. Her recommendation was that the manufacturers should shape the negative to the form it would naturally acquire after burning for that time, so that practically no interval should occur in the searchlight during re-carboning. The usefulness of this simple suggestion can be seen in the fact that the official time allowed in the Navy drill for changing the carbons of a searchlight is forty seconds.

Mrs. Ayrton's investigations with regard to searchlights did not end with these four reports. Up to the year 1910 she was constantly experimenting on the Admiralty arc carbons for this purpose, and she effected several improvements in them. A later investigation that she was asked to make for another purpose led to further discoveries with regard to electric arc carbons, which will be treated in the next chapter. At one stage of the Admiralty work, about the time that she won the Hughes medal, we find her writing to Mrs. Zangwill: "I have received a request for an article 'on some electrical subject' for *The Times* Engineering Supplement, and I am going to write one on the work I did this

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summer for that Admiralty report of Father's." The result was a very lucid account of "Roaring Searchlights," which appeared in *The Times* Engineering Supplement of November 28, 1906.

For two years after Professor Ayrton's death in 1908, suffrage and science alternately occupied Hertha's mind and time. She was engaged during this period in revising her 1904 paper on "The Origin and Growth of Ripple Mark" for the Press, the only important paper she ever published in which she made her own drawings, a task that gave her some trouble as well as satisfaction. "I am rather proud of the drawings"—she writes to Barbie on this subject—

"because they are actual reproductions of my own drawings, the first time I have done them well enough for this to be possible. It will also be the last, because it is not in the least worth while to give so much time to what a professional draughtsman could do so much better. So in future I shall employ the R.S. draughtsman before I send my paper in. It is a great shame to have to do this —not for me; I can afford it—but it would be a great tax on a poor person and might keep a very good paper from being published. But the R.S. proceedings with regard to papers need a thorough reform. Every one knows this, and yet, like 'every one's business' at all times, it does not get done. Of course I can do nothing, because I am a mere outsider, being a woman!"

She was further engaged at this time in the preparation of two new papers on sand ripples and vortices, embodying her later experiments. After her husband's death, she removed her laboratory from the top story of the house at Norfolk Square down to the large room on the first floor, sacrificing her drawing-room for the purpose. There is no record that Barbara, having now grown up and drastically revised her sense of values, objected to this rearrangement of the house on the score of its not being in accordance with the common usage of people of fashion! Barbara was much away

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from home in the two years intervening between her father's death and her marriage. In January, 1909, she definitely undertook the work of organizer for the Women's Social and Political Union, and the strenuous career thus involved would in any case have put social amenities at home out of the question for her. Nor did Mrs. Ayrton herself, beyond being always ready to give hospitality to those who needed it, again entertain on a large scale, perhaps feeling that this particular social chapter in her life had been closed by the Professor's death. In any case, she had little leisure for such distractions.

Her correspondence at this period is sufficient to show how science and politics fought for the monopoly of her time, sometimes rendering it a hard task for her to keep the balance between the two. On one occasion, at the end of 1908, it is a letter from Lady Constance Lytton, to ask for her signature to a petition to the King, requesting him to use his influence with his Ministers to secure political treatment for suffragist prisoners. On another, it is an invitation from Miss Ethel Sargant, F.L.S., to sit in the box reserved for women of science at an Albert Hall suffrage meeting. Or again, she is approached for the purpose of securing signatures of scientists to a Men's Declaration in favour of woman suffrage—not at all an easy task, this, though faithfully attempted in spite of its unpleasantness. For while, in this last instance, some were ready enough to consent, others, like Sir Oliver Lodge, were prepared only with an academic acceptance of the principle, combined with a strong condemnation of the anti-Government policy of the W.S.P.U., which was described as "not only disastrous, but nearly akin to lunacy." Others, again, went still further and declared themselves active opponents. For instance, Sir Archibald Geikie, President of the

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Royal Society, writes to Mrs. Ayrton: "Much as I sympathize with women in their intellectual work, I should be sorry to see them mix themselves up in politics"; while Mr. Francis Galton, the eminent physicist (afterwards Sir Francis Galton), begins his reply with the unpromising though candid remark: "You have asked a Balaam to bless your cause!" But some old friends were less unsatisfactory. "I had Professor Perry to dinner last night," writes Mrs. Ayrton in one of her letters to Barbie; "he is very strong against militant policy and wouldn't even discuss it, but I got him to sign the Men's Declaration."

No one ever called upon her in vain for support; whether it was to walk in a suffrage procession—there were sometimes two a year, and delicate as she was, she walked in every one; or to open a suffragette Fair—one at Prince's Skating Rink in May, 1909, and another at the Portman Rooms in November, 1911; or to fill her house with suffrage delegates from the provinces, and ex-prisoners from Holloway; or, worst of all, to make a speech, which interrupted her scientific work almost more disastrously than anything. She referred humorously to her preoccupation with suffrage matters in the opening words of an address she gave to Bedford College students, on November 6, 1909—not, of course, a political occasion:

"I had quite made up my mind to address you on 'Intellectual Sincerity' and began talking it over with my daughter, telling her what I meant to say. Suddenly I saw that she was struggling with laughter, and I asked for the reason, having never felt more serious in my life. 'Well,' she said, 'I've heard it called all sorts of names, but never "intellectual sincerity" before. Do you know you have been talking woman suffrage for the last quarter of an hour?' So I had to give it up and practise what I was going to preach; and I frankly own that what I have to say is intimately connected with woman suffrage."

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In giving money to the militant organization she showed herself as lavish as in all other matters where giving was in question; and her personal expenditure was restricted in consequence for the rest of her life. "I have sent Mrs. Pethick Lawrence [1] £200," she writes to Barbie in March, 1909:

"It seems to me that I had much better use some of my own private capital in this way now, when it is a case of 'a long pull, a strong pull and a pull all together,' than hoard it up to leave to other people. I mean in any case to use the money Madame left me for causes, etc., so I should leave it anyhow to be used for public purposes; and therefore I may as well dispose of it in that way during my lifetime. It makes me very happy to think that I can do this. At the same time, I want to do it cautiously, that is why I am starting with £200 only."

With similar disinterestedness she never stopped to count the cost to her public reputation that was involved in almost any advocacy of woman suffrage as the struggle grew more intense and feeling became embittered, and she lost no opportunity of writing to the Press if it seemed probable that her name at the end of a letter rendered it of any value to the movement. In September, 1909, in company with Mrs. Ramsay MacDonald and other well-known women, she wrote to the *Daily Chronicle* to combat Professor Armstrong's sweeping assertion that the "revolt of women" would fail, and that woman in her failure would "carry man with her to destruction." But, although throughout the suffrage campaign she had constantly to meet attacks both upon the suffrage principle and the tactics of the militants, there were compensations in the fact that the controversy was often conducted in the friendliest spirit. Once, staying at Crowborough with her old friend Ottilie

[1] Mrs. Pethick Lawrence was the Honorary Treasurer of the W.S.P.U.

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Hancock—who became a widow in 1909—she writes to Barbie as follows:

"Mrs. Hancock and I spend the time, when we are not out of doors, in discussing, I may almost say sparring, over things 'social and political'; and she nearly always finishes by saying, 'Oh, Hertha, you are such a Radical!' . . . However, I plead guilty to the soft impeachment, and then we generally end with a laugh."

In a later letter, she mentions that Mrs. Hancock is heartily disgusted with the official Liberal attitude towards the suffrage question, adding, however—"I do not think she will ever actually join the W.S.P.U."

This surmise proved correct, for Mrs. Hancock never did become a militant; but she was far too sincere a suffragist not to sympathize very thoroughly with the reasons that made her friend one, and no one was more admiring and sympathetic than she was when Barbara went to prison for her principles, in 1912.

All this time, Mrs. Ayrton continued her research work in the laboratory, making many fresh experiments and pursuing her investigations into the movements of water. She was especially engaged in making a minute pressure-difference gauge which was designed to meet the objections raised by some of her Royal Society critics in 1904; on that occasion they had thrown doubts upon the way she arrived at conclusions drawn from one of her experiments, in which she placed an artificial barrier across the sand in her tank to demonstrate the ripple-forming vortices. On December 31, 1909, thinking she had achieved her object (as a matter of fact, she did not perfect this remarkable little piece of mechanism for some years, and showed it publicly for the first time in 1915), she wrote as follows to Barbie about it:

"The little apparatus I have been fidgeting over, and altering and fiddling at for weeks, has at last come right and shows exactly

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what I meant it to. Of course it is much simpler than any of the plans I had tried before; that is always the way. Anyhow, now I must write to Lord Rayleigh to tell him about it. I am so glad it has come off at last."

Added to the strain of combining the rôles of scientist and suffragist was the constantly recurring doubt as to whether, holding her militant views, she was quite honest in abstaining from putting them into practice. Possibly, her uneasiness on this point was fostered by the militant activities of her daughter, who, besides risking arrest in the W.S.P.U. demonstrations in Parliament Square, was constantly going through the experience of making protests at Cabinet Ministers' meetings against the Government's suffrage policy (or want of it), the inevitable consequence of such protests being forcible ejection by stewards none too nice in their methods. In the case of a woman as sensitive and as conscientious as Hertha Ayrton, almost greater suffering was involved in abstaining from militancy than in taking part in it; for she heard constantly from Barbara of what she and others were doing all over the country. It was Barbara, as a matter of fact, who chiefly restrained her mother from militant action, on account of her health, which had naturally suffered greatly from the three years' nursing in her husband's sick-room.

It should be explained here that to take part in a W.S.P.U. deputation to the House of Commons demanded both nerve and endurance. Until 1911, the policy of the militant suffragists was one of passive resistance; and in deference to an ancient statute, which forbids a procession of more than thirteen persons within two miles of Westminster while Parliament is in session, the women used to sally forth from a meeting in Caxton Hall, half a mile away, in small bands of twelve, each bearing a suffrage petition framed in accordance

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with the political situation of the moment, with the avowed intention of entering the House of Commons and presenting it to the Prime Minister. In order to prevent them from executing their purpose, the police surrounded the House; for the Government policy under three successive Home Secretaries was to avoid as far as possible the odium of arresting suffragists, and the police endeavoured to carry out the Government's intention by hustling the demonstrators in the hope that they would desist in their attempt to enter the House and go quietly home. They never did desist, and were sometimes in consequence knocked about for hours before being arrested, the rougher elements of the crowd often reinforcing the police in this interpretation of the Home Secretary's policy.[1]

The W.S.P.U., therefore, discouraged volunteers who were not sufficiently robust to face this experience; and, in Mrs. Ayrton's case, they were further of opinion that she could help the movement better by remaining in her laboratory. But although this was originally her own view, it became daily more difficult for her to maintain it, and to look on, inactive, while others endured. In August, 1909, she wrote thus to Barbara:

"I feel dreadfully inclined to send in my name for the next deputation. Should I really do more harm in the scientific line than good to the cause? That is what worries me and keeps me from making up my mind. I shall see how my work goes and whether I am likely to do something very good this autumn, before I decide."

The decision was postponed, however, for another year. In February, 1910, after the General Election, a Conciliation Committee of Members was formed in the House of Commons to promote the suffrage measure

[1] The Metropolitan Police Force is under the control of the Home Office.

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known as the Conciliation Bill, which would have enfranchised about a million women of all classes; and in order to give the Bill every chance—"Where there's a Bill there's a Way," as one of the W.S.P.U. banners put it—a truce was called to militancy for nine months. During this period, Mrs. Ayrton took part in much of the peaceful propaganda promoted by all suffrage societies, including a very long procession through the streets of London to a meeting in the Albert Hall on June 18, 1910, as well as a Hyde Park demonstration on July 23. It was on the occasion of one of these demonstrations that a 'bus-driver, tired of being held up at Piccadilly Circus by a continuous stream of women processionists, and probably finding them, as the harassed Government did, "terrible as an army with banners," called out impatiently: "Oh, for God's sake give 'em the vote, but don't let them hold up the traffic!"

No doubt, Mrs. Ayrton felt the effect of all these activities upon her work and her strength, for we find her writing rather dispiritedly (for her) to Barbie, at the end of July, 1910:

"Adela Pankhurst has written to ask me to address members of the British Association at a garden party on behalf of the W.S.P.U. I suppose I ought to do it, but oh, dear me! I wish the Bill would pass so that I could be left in peace to do my own work. I am a selfish thing. . . . I feel a sort of inward white rage that we should have to waste our lives and our energies as we are doing, in order to secure the most elementary justice. However, this is not talk for honeymoon couples!"

The allusion in the last sentence is, as may be supposed, to Barbara's marriage, which took place that month. Mr. Gerald Gould, now widely known as the author of several books of verse and of prose, and a critic and essayist as well, was already enjoying a *succès d'estime* both as poet and scholar when he

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became engaged to Barbara Ayrton, whom he had first met when she was a student at University College. At the time of his marriage, he was a Fellow of Merton College, Oxford, and Fellow and Quain Student of University College, London. He was a sound suffragist, and he gave very much more than an academic adherence to suffrage principles, for up to the end of the campaign he was generous with help both as a writer and the wittiest of speakers. But his greatest contribution was, no doubt, his unconditional acquiescence in his wife's devotion to the movement. After their honeymoon they returned to town to live in the neighbourhood of Norfolk Square; and Barbara at once resumed her work as a W.S.P.U. organizer.

The garden party in connection with the meeting of the British Association at Sheffield was given at the beginning of September, 1910, by Professor Beattie of Sheffield Uinversity, and his wife; and of course Mrs. Ayrton acceded to the request for an address on woman suffrage. It was soon after this that a conjunction of circumstances put an end to her uncertainty and brought about her one participation in militant action. The Conciliation Bill having passed its second reading in 1910 by a substantial majority in the Commons, hopes were actually entertained of its being given further facilities in the autumn. These hopes were, however, dashed to the ground when the Prime Minister announced his intention of going to the country, and, outlining the programme of his party, made no mention of woman suffrage.

A Caxton Hall meeting of women was in progress on Friday, November 18, 1910 (afterwards known in the movement as Black Friday), when Mr. Asquith's barren pronouncement was made in the House; and three hundred volunteers, in groups of twelve, set out to en-

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deavour to reach the presence of the Prime Minister and protest to him in person. The certain prospect of meeting with rough treatment and other indignities did not deter several women of advanced years and high public reputation from taking part in this deputation; and the first group to start from Caxton Hall included Mrs. Hertha Ayrton, M.I.E.E.; Mrs. Garrett Anderson, M.D., ex-Mayor of Aldeburgh and England's first woman doctor; her daughter, Dr. Louisa Garrett Anderson, the eminent surgeon afterwards to be decorated (C.B.E.) for her services in the war; Mrs. Cobden-Sanderson; Miss Neligan, late head mistress of Croydon High School; Mrs. Brackenbury, widow of General Brackenbury; Mrs. Saul Solomon, President of the Women's South African Federation, and the Princess Sophia Duleep Singh. This representative body of women, some of them over seventy years of age, were headed by Mrs. Pankhurst and proceeded to walk along Victoria Street to the House. They were greeted with cheers from people on passing omnibuses, who at least admitted their persistence and courage, while their peaceable intentions were apparently recognized by the police escort that accompanied them as far as Parliament Square.

Here a dense crowd had assembled, and it was soon obvious that a very large element of it consisted of rough and ill-dressed men and lads, who did not suggest the kind of people one would expect to find in Parliament Square in the afternoon, or, on the other hand, a typical working-class crowd. The police escort deserted the little deputation on the edge of the Square, and immediately the roughest treatment was meted out to them from all sides. Friends of the movement were unable to reach the band of petitioners, who were soon separated and thrown from side to side by police and hooligans

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alike. The petitioners, however, persisted in their attempt and finally struggled through separately until all twelve stood on the steps of the Strangers' entrance. Here, with some inconsistency, they were once more treated as respectable members of the public and taken under police protection, while their request was sent in to the Prime Minister.

There was no inconsistency about Mr. Asquith, for he still declined to receive the deputation; but his private secretary, Mr. Vaughan Nash, saw three of them, of whom one—Hertha Ayrton—must have smiled to recall early days when, as Sarah Marks, she taught his wife, then Miss Shore-Smith. Finding that Mr. Nash had nothing fresh to tell them, the deputation returned to the doorstep, where they stood for six hours, witnessing the violence with which the efforts of their companions to join them on the doorstep were met. The Home Secretary (Mr. Winston Churchill), when questioned in the House afterwards as to the orders issued to the police on this occasion, replied that he had given certain directions to them with a view to their making as few arrests as possible; but he afterwards denied having given them any orders at all. In the following letter, written to Mrs. Zangwill after Black Friday, Mrs. Ayrton comments on the first of his two replies:

"You can see from Churchill's reply in the House yesterday that the order had been given not to arrest but to wear out and terrorize the women. We heard that this was so on Friday before we started, and we were not long in finding out what it meant. Before any of us, including Mrs. Pankhurst and Mrs. Garrett Anderson, could get to the House we had to run the gauntlet of organized gangs of policemen in plain clothes, dressed like roughs, who nearly squeezed the breath out of our bodies, the policemen in official clothes helping them. When Mrs. Pankhurst and Mrs. Garrett Anderson had got through, it was still worse for the rest of us. I nearly fainted, and Louie Garrett Anderson succeeded in making them let me through. Mrs. Saul Solomon was seized by the breasts and thrown

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down. Women were thrown from policemen in uniform to policemen in plain clothes, literally till they fainted. A lady told me a policeman had told her he would kick her when he got her down —and he did. A man came up and said to her: 'I have been against women's suffrage all my life, but by God, I hope you'll get the vote now!' He said to the policeman: 'You're not a man, you're a brute.' What a libel on the brutes!" [1]

Mrs. Ayrton again took part in a militant demonstration on the following Tuesday, when another meeting of women was held in the Caxton Hall, to await a declaration on woman suffrage that the Prime Minister had been impelled by pressure from the Conciliation Committee to include in his final speech before the Dissolution of Parliament. It was considered quite unsatisfactory when it came and was received by the waiting assembly of women with cries of "To Downing Street!"—Parliament being by that time dissolved. The whole audience rose spontaneously and, led by last Friday's principal deputation, including Mrs. Ayrton, poured out into the street and walked rapidly, though in orderly fashion,

[1] Lest this account should appear exaggerated, it may be added that as a sequel to "Black Friday," the Conciliation Committee undertook an inquiry into the allegations of ill-treatment at the hands of the police that were made by the women suffragists, and they examined 135 witnesses, including doctors who saw the state of the women's bodies afterwards. The Committee came to the conclusion that a *prima facie* case for a Government inquiry had been made out, an opinion in which Lord Robert Cecil, M.P., and Mr. Ellis Griffiths, K.C., M.P., concurred after examining a proportion of the witnesses independently. Lord Robert Cecil concluded his report with the words: "May I ask whether any one thinks that if the deputation had consisted of unarmed men of the same character their demand for an inquiry would have been refused? . . . Are we then to take it as officially admitted that in this country there is one law for male electors and another for voteless women?" Mr. Winston Churchill, who was again Home Secretary in the newly elected Parliament of 1911, persisted in his refusal to grant an inquiry; and the Government supported his decision.

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along Tothill Street and up Whitehall to the official residence. The police, taken by surprise, had only time to throw a thin line of men across the end of Downing Street, who were scattered at once by the steady impact of the women. Reinforced, however, by a large body of constabulary waiting in reserve in the Foreign Office yard, the police soon cleared the street by main force, making many arrests though avoiding known personages as before.

In a letter to *The Times* that was not inserted, Mrs. Ayrton endeavoured to correct the insufficient report which appeared in that newspaper by giving her own eye-witness account of what came to be known among suffragettes as "The Battle of Downing Street." "I was marching immediately behind Mrs. Pankhurst when she entered Downing Street," wrote Mrs. Ayrton, "but was prevented from reaching No. 10 by an attempt at strangulation on the part of a policeman. I remained until the whole street was cleared, and I saw all that went on there. . . ." In a further letter, written in answer to one from the editor, explaining his reasons for not publishing her first communication, she says:

"Your reporter says he saw no brutality on the part of the police, but I not only saw but experienced it. Twice, policemen seized me by the throat and jerked my head back till it felt as if my neck would break, so that I quite lost my breath and half lost consciousness for a time; indeed I must have fallen down and been trampled on, as were other women, had I not been held up by my daughter."

To Mrs. Zangwill she relates further that, the second time her head was bent back—

"Barbie shouted at the constable: 'You dare not hurt that lady; she is Mrs. Ayrton!' and he let me go. We heard afterwards that there were special orders not to arrest Mrs. Anderson or me. The heroism of the women, especially the old ladies, their cheerfulness and determination, were beyond all praise."

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With reference to the "old ladies," a joke was current in militant circles after the events of November, 1910, to the effect that in future no one over eighty would be eligible for militant action by the W.S.P.U. Until the following November, however, no militancy of any consequence took place; and, immediately following the events described in this chapter, the General Election and the Christmas Recess left Mrs. Ayrton at liberty to concentrate on her own work.

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CHAPTER XVI

A REVERSE, A TRIUMPH AND A CONSPIRACY (1911–12)

Mrs. Ayrton's participation in the militant demonstrations of November, 1910, led to the postponement of her paper, "On some new Facts connected with the Motion of Oscillating Water"; as she fully expected to be in prison on November 21, the date on which she had engaged to read it before the Royal Society. She read it on January 26, 1911, instead. This paper she regarded as a continuation of the one she had given in 1908, "On the Non-periodic or Residual Motion of Water moving in Stationary Waves," which had been duly accepted by the Royal Society. Some of the deductions from her experiments in the new paper were, however, questioned by the Referee who criticized it for the Society, and she was held not to have proved her point. One of her experiments, it will be remembered, had been similarly questioned in her 1904 paper on the "Origin and Growth of Ripple Mark," although that paper had been accepted. In the case of the 1911 paper, however, acceptance did not follow; and Mrs. Ayrton felt the rejection very keenly, being convinced, as she indeed afterwards proved, that her reasoning was sound. Her sense of injustice was the greater since the Referee, whose identity was not revealed to her, had not been present at the meeting when she read the paper, and did not accept her invitation to

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come to her laboratory afterwards to see the experiments for himself. "I have not yet got the Referee's criticisms out of the Royal Society," she wrote to Barbara in February, 1911; "though I have at last extracted an authorization from Professor Poynting to show them to me."

It is possible that she was over-sensitive about the rejection of her paper, being perhaps suspicious of a change of attitude on the part of her fellow-scientists on account of her championship of militant suffrage. Only those who have jeopardized a valued position of some sort by embracing an unpopular political or humanitarian cause can appreciate this particular kind of sensitiveness, to which Hertha Ayrton became prone, especially during the later period of her life. Signs of it are discernible in a further passage occurring in the same letter to Mrs. Gould:

"It is rather depressing to have to fight like this on all sides and in every phase of one's life (except, thank goodness, the domestic one!), but I often think of the enormous amount of injustice that is being done daily all round, and the humbug and bunkum that hide it, and then I wonder at myself for even hoping to be exempt! Who am I that I should expect to meet justice and fairness in such a world? But the enormous waste of it all and the degradation of ideals does sometimes oppress me. Israel says he feels exhilarated by the fight, and so, I know, do you. I don't; I wish I did, and yet I have to go on fighting; I can't help it. If I could even express myself, I should mind it less. But of all the mass of thoughts that come seething up in my mind, only a few little half-inarticulate phrases, a sort of flotsam and jetsam, will come out."

Her comments on the Referee's criticism of her paper, preserved on the margin of the copy she obtained of it, suggest the possibility that her disregard of the common nomenclature of mechanics—the unconventionality, in fact, that always marked her method of research—probably accounted for some of the misunderstanding of her

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paper. The Referee says, for instance, that "she has brought to light a number of interesting facts and exhibited them in a very beautiful way, but the reasoning throughout appears defective"; and further that—"she speaks of a back pressure producing a vortex, which it is quite incapable of doing."

On this Mrs. Ayrton comments: "This is a complete misstatement of my views. I speak of a *difference* of pressure producing a stream in one direction, while another stream is flowing over it in the opposite direction, and of the two streams producing a vortex." And she disposes of the arguments he advances in support of his objection by saying bluntly—"This whole hypothesis is directly contrary to the results of experiment. I will venture to affirm that the man who made it has never seen a ripple vortex in his life." The misunderstanding, or whatever it was, was not cleared up until 1915, when, in her paper[1] on "Local Differences of Pressure near an Obstacle in Oscillating Water," she completely refuted the objections of her critics to her former experiments by the use of a perfected difference-of-pressure gauge, against which no accusation of fallacy could be brought; and this paper, as will be seen, was accepted by the Royal Society, its acceptance involving the automatic acceptance of the rejected paper of 1911, as well as proving the soundness of the experiment objected to in her 1904 paper.[2] Circumstances, however, as will duly appear, combined to interfere with Mrs. Ayrton's revision and recommunication of the rejected paper, which was therefore never published among the *Proceedings of the Royal Society*.[3]

Her disappointment over her 1911 paper, the one real scientific reverse of her life, was considerably softened

[1] See Chapter XVIII. [2] See Chapter XIII.
[3] See Chapter XIX.

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by the decided success she enjoyed when, in May of the same year, she went to Paris in response to an invitation from the Société française de Physique (the French counterpart of the Royal Society) to lecture on her discoveries in the movements of water. She wrote to Barbara that she intended to make this paper "a compilation from all my papers on water," and by this second visit to Paris she undoubtedly enhanced the reputation she already enjoyed among French scientists, who had heard her give her paper at the International Electrical Congress in 1901 on "L'Intensité lumineuse de l'Arc à Courants Continus,"[1] and were now keenly interested to hear what she had to say on "La Formation des Rides de Sable et les Mouvements internes de l'Eau oscillante."[2]

In the letter she wrote to her daughter, on May 20, 1911, the morning after the lecture, there is some evidence of the despondency which commonly seizes the public speaker on the morrow of an appearance on the platform. "I could do it so much better another time!" she complains, but goes on to give an amusing description of the difficulties she had to encounter, on the afternoon preceding the meeting, when preparing her experiments in a fourth-floor room to which, although provided with all kinds of electrical appliances, every drop of water had to be brought from below:

"Mine was not the only paper for the evening; there were two others, and one was on the conjunction of the cinematograph with the phonograph in order to produce scenes from life. The

[1] See Chapter XI.

[2] A summary of this paper may be found on pp. 62–3 of the published Proceedings of the Société française de Physique for 1911, entitled "Procès-verbaux et Résumé des Communications faites pendant l'année 1911" (published by Gauthier-Villars, 1912).

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rehearsals took place all the afternoon with an enormous loud phonograph. I had to shout instructions to Mr. Greenslade [1] through the crowings of a cock loud enough to split one's tympanum, or the shouts of an angry man at the telephone, or the bawling of a lecturer who was explaining the invention. Meanwhile the cinematograph was going, and anyone who had come into the hall unawares would have thought he had strayed into a lunatic asylum—ducks and crocodiles bowing to one another in the middle of my six-foot trough full of swinging water, cocks crowing, sand being swept along in another trough, electric lights being swished on and off—you never heard or saw such a pandemonium. . . . Considering all these difficulties I think it went off very well, but oh, it ought to have gone so much better! The experiments themselves were a great success; they behaved beautifully, but there was not enough time to show so many. However, people stayed on and saw some of them again, and in fact had to be turned out by the concierge."

After narrating the renewal at the Société de Physique of her acquaintance with Madame Curie, she goes on to say:

"But I haven't told you the most important thing of all! The cinematograph man came up to me after the lecture and offered to take films of all my experiments and give them to me, so I shall have a cinematograph show of the whole lot. Yesterday was entirely spent at his place, and we did the aluminium ones; it will take days more to do the rest. But isn't it splendid?"

It is delightful to read her Paris correspondence; for she appears to have experienced a genuine triumph there and to have rejoiced that her conclusions, some of which had been questioned by members of the Royal Society, were understood and accepted by the French physicists. She stayed with her cousin, Madame Dar-

[1] Mr. Greenslade played an important part, both now and later, in assisting Mrs. Ayrton in carrying out her experiments and also in her public demonstrations of these experiments. He was originally a pupil of Professor Ayrton and later became his assistant at the Central Technical College in South Kensington. After Professor Ayrton's death he was appointed lecturer in electricity at the Crawford Technical Institute, Cork.

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mesteter—met many interesting people, and had a thoroughly good time away from politics and other distractions. Her old natural gaiety reasserted itself, and the following extracts from her letters to Mrs. Gould afford evidence of her enjoyment of this Paris visit:

"I think perhaps I gave you rather too depressed an account of my 'Conférence,' but Nelly is going to write a correction. It is not exactly anyone's fault that I had such difficulties beforehand; they had tried to arrange it differently, but circumstances were too much for them. M. Abraham, the Secretary, was most kind, and so in fact was everybody. The President, in thanking me, said I had managed to build up for myself an enduring monument in sand, and that this time physics had got beforehand with mathematics, and he hoped mathematics would hasten to make up for lost time. It was very prettily put.

"We went on Sunday to Madame Chavanne's, who gave a large luncheon party for me and Madame Curie. Madame Curie came to the station to meet us, which I thought very nice of her. She spoke of you with great affection, saying you had made a great impression on her, you were so fresh and simple and had such a look 'de fierté et de courage.' After the lunch, as I should have had no time to go and see Madame Curie again (she lives a little way out), she asked Nelly and me to return home with her for a little while, which we did and saw her two daughters, both very interesting children. . . . I spoke to Madame Curie about coming to see us this summer, but she says she has arranged to go to her sister at her old home in Poland, this year, but would much like to come with the two children next summer. . . .

"I had a little demonstration of experiments at Nelly's At Home yesterday; and it was as successful as they always are, every one crowding in to see them. Madame Curie and another Professor, who used to be the Curies' assistant, were immensely interested and delighted, and the many artists went into raptures over the aluminium experiments. Altogether it was quite a triumph, and I was glad to be able to go into things more fully with the physicists.

"The cinematograph is swallowing me up, too. They have taken thirteen experiments—seventeen films, because they have made five films of the building up of the sand in the big trough, at various stages. No time to tell you of the visit to the wireless installation at the Eiffel Tower, by special permission, being received by a posse

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of soldiers saluting, and shown everything like a queen. My stars, I *am* having a time!"

Like her first Paris paper in 1901, this second one was given in French, and no doubt her fluent French contributed to her success. It is therefore the more unfortunate that bad health and the intervention of the war together prevented her from following up her success by a later visit to Paris. Had she been a better sailor—she suffered so much on the sea that even the shortest Channel crossing incapacitated her for some time—she would have been able, not only to revisit the Société Physique, but to accede to one of the requests she also received from time to time to cross the Atlantic and lecture in the United States.

On her return to England, Mrs. Ayrton continued to work at her water experiments, besides preparing her Paris paper for publication; but scientific research was conducted only intermittently for the greater part of 1911. The census protest, organized by the Women's Freedom League in the spring of 1911, was one of the many interruptions that occurred in her work. On this occasion, Mrs. Ayrton turned her rooms into dormitories for the night, hiring beds, and giving hospitality to some forty census-resisters, all of them women workers who could thus with her help escape notification, their hostess having declined to fill in her census paper or give any particulars of the people under her roof. Perhaps this action of hers showed more decidedly than anything else what a rebel Hertha Ayrton had been made by her passionate sense of the injustice to women involved in their continued disfranchisement; for, very naturally, as a scientist, she would attach special significance to the accuracy of the census returns.

Barbara Gould, then away on a voyage with her husband who had recently been ill, received several

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letters on the subject from her mother, in one of which she wrote:

"Every man I know, except Israel, is upset at the idea of our spoiling the census. Last night, at Cécile's dinner (very successful), I sat next to a Professor Arnold, who took that line; and in the afternoon the Thompsons called, and Dr. Thompson and I had quite an argument about it. All these men are suffragists. . . . My reply is that if the men think the census so important they should let Asquith know he must grant facilities for our Bill this session; then we should be quite willing to carry out any duties of citizenship that happen to fall on us."

And again:

"At Mrs. Hancock's dinner party on Friday, Mr. Cowan said he was going to ask a question in the House to-day about what the Government were going to do to keep suffragists from spoiling the census. I told him he could not do us a greater service, and begged him to couch it in strong language. He was quite sure that the Government would find some way of circumventing us, by passing a short Bill making the punishment for evasion much heavier, or changing the fine to imprisonment. I told him I hoped they would do that, because the more the Government tried to circumvent us the more serious they showed our action to be, and the more hopeless to try to govern us without our consent."

The Government, as will be remembered by suffragists, did not attempt to prosecute the census-resisters, on the pretext that their number was negligible. About this time, Mrs. Ayrton wrote to Barbie to describe a large suffrage meeting in the Albert Hall, a letter which is interesting on account of its allusion to Dr. Ethel Smyth, the musician, who had recently joined the Women's Social and Political Union:

"First of all Mrs. Pankhurst made a speech to Miss Ethel Smyth, who was in her Mus. Doc. gown, which, strange to say, is white with *heliotrope*[1] facings. She presented her with a bâton from the Union, to show its appreciation of the way she was devoting her musical talent to women. Then Miss Smyth made a very pretty

[1] The W.S.P.U. colours were purple, white and green.

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little speech in reply, and immediately used the bâton to conduct her Women's March, which was led by a chorus on the platform (all in white and wearing the colours) and was sung by the entire audience. As, however, it was played by the organ and consequently sung at least a tone higher than it was written, it became rather a shriek!"

In the monster suffrage procession organized by all the suffrage societies, which marched through London on June 17, 1911, Mrs. Ayrton walked with the science section, though debarred by her reactionary *alma "step"-mater* from doing so in cap and gown. The medical women in their academic robes were the occasion of an amusing story; marching past in a solid phalanx hundreds strong, they made such an imposing effect as to cause one bystander to remark ironically to his neighbour—"Look, Bill! There goes our spare rib!"

Mrs. Ayrton did not again take any active part in militant suffrage demonstrations, though, right up to the outbreak of war, she helped the movement in various ways. In the demonstrations of March, 1912, when large numbers of Government office windows, as well as shop windows in the West End of London, were broken by the militants, Mrs. Gould became involved; and her mother wrote briefly to Mrs. Zangwill on the morrow of her arrest:

"Barbie is in Holloway, having, with all the others, refused bail. Gerald and I were at Bow Street most of yesterday, and saw her. She looked ghastly when she came to tell me about it the night before. Now that it is done, she is looking better and is quite happy. She is to be tried on Wednesday. I am *very* proud of her."

She wrote again to Edie, on the following day:

"London is in an uproar and really panic-stricken, I think. They are calling in soldiers to arrest the women, which is ludicrous since no one makes any resistance; but I believe it is because there are

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not enough policemen to go round. Oh, I am so sick, so sick, when I think of it all, and of my little Barbie in prison, and the waste and needlessness of it."

As a result of all these disturbances, the leaders of the W.S.P.U. (with the exception of Miss Christabel Pankhurst, who escaped to Paris) were arrested on a charge of conspiracy, and at the height of the situation thus created Mrs. Ayrton became the means by chance of doing a signal service to the Union. There was a rumour that the Government meant to seize the funds of the W.S.P.U. and the cheque came into the hands of the present writer for transference to a place of safety. So, early one morning in March, 1912, I presented myself in Norfolk Square to the maid who was cleaning the doorstep, and sent up an urgent message to her mistress, who was breakfasting in her room. Nothing surprised any member of the Union at this crisis in their fortunes, and I was able within five minutes to hand my cheque to her. She was full of resource, as I expected to find her, and as much unruffled by my news as if she had been engaged all her life in executing commissions of doubtful legality for friends whom the law dubbed conspirators. I remember thinking, as she sat there calmly drinking her coffee and thinking out the problem of disposing of the funds, that it was not easy for any Government to crush a movement composed of women like her, naturally devoted to law and order, who were prepared to defy the law for the sake of a cause that they felt as voteless women to be above the law.

She told me afterwards that she took a cab to her bank as soon as it opened, and paid in the cheque to her account, whence it was drawn out again, a few hours later, and transferred abroad. Whether the funds would, or, indeed, could legally have been appropriated, was a problem that never arose; for by the time the

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sun set that day, there were no rebel funds left in this country to confiscate. But the recollection of that little transaction, the secret of fewer than half a dozen people until this moment of its disclosure, was always a very pleasant one to Hertha Ayrton.

A mass meeting of militants was held in the Albert Hall on March 28, 1912, as a reply to assurance that the militants were "on the run," as one member of the Cabinet expressed it; and at this meeting Mrs. Ayrton made a donation of £1,000 to the W.S.P.U. funds, in pursuance of her project to dispose of the money that she considered had been left her in trust for the woman's movement. Two others followed her example at the same meeting, at which Mrs. Besant spoke as well as Elizabeth Robins and Israel Zangwill, the latter concluding a witty description of the anti-suffragists, or the "Hithertos," with the ringing words, "We—*we* are the Henceforwards!"

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CHAPTER XVII

MILITANCY AND WAR (1912–14)

It may be remembered that the three militant leaders, who were sentenced in May, 1912, to nine months' imprisonment, were released soon afterwards as a result of a hunger strike, on the tacit understanding that they would refrain from organizing militancy until the term of their sentence should have expired. Much pressure was brought to bear on the Government to secure this arrangement, and amongst other methods an international petition was promoted, on behalf of which Hertha Ayrton wrote as follows to Madame Curie:

"I enclose a copy of a letter that is being sent to many people of international fame, in the hope that you will allow your name to be used on the petition mentioned in it. I am a member of the association whose leaders are now in prison, and I know those leaders personally and look on them as persons of the utmost nobility of mind and greatness of purpose. May I hope that you, whose name is a household word among us and will command respect from the whole civilized world, will help to procure this act of justice for those who are devoting their lives to procuring the enfranchisement of women in England?"

To this letter Madame Curie replied at once, saying: "J'accepte que vous utilisiez mon nom pour la pétition dont vous me parlez, car j'ai grande confiance dans votre jugement, et je suis convaincue que votre sympathie doit être justifiée." That women should go to prison for a cause was never a matter of surprise to

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Madame Curie, whose home was in Poland where, as she once told us when we were all three discussing the matter, it was considered rather against a member of a good family than otherwise not to have been to prison for the sake of Polish independence. In another letter to Mrs. Ayrton, she wrote in reference to the suffrage movement: "J'ai été très touchée par tout ce que vous me dites de la lutte des femmes anglaises pour leurs droits; je les estime beaucoup et je souhaite leur succès."

Mrs. Ayrton showed her relief at Barbie's release from Holloway Gaol by writing her directly afterwards a gay birthday letter:

"I simply refuse to believe you are grown-up. How can a little snippety thing like you be grown up? Absurd! Something's gone wrong with the calendar; and besides, I can see you opening one eye at me (the reverse of winking) the first moment I saw you, just as if it had been yesterday. I remember that a sort of rapid vision of you at various ages rushed through my mind, just as drowning people are supposed to review their *past* life, and I wondered what you would be like as a little girl, as a big girl, as a woman. All my visions, however, fell far short of the reality, I am very sure, though I cannot recall the pictures now. One thing I did *not* foresee, and that was your last experience of any note that ended last Thursday week! Well, darling, I wish you many, many happy returns, and that some day you may be able to write M.P. after your name." [1]

Mrs. Ayrton, in common with many women, unpolitical by temperament, who had made real sacrifices for the militant cause, was deeply concerned over the split in the W.S.P.U., which occurred in October, 1912, when

[1] Mrs. Ayrton Gould unsuccessfully contested the North Lambeth division of Parliament in the General Election of 1922, and the Northwich Division of Cheshire in that of 1924, on both occasions in the Labour interest. At the moment of writing, she is the adopted Labour candidate for the latter division.

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the Pankhursts separated from the Pethick Lawrences, and *Punch* summed up the situation in a picture of two modern girls, the one asking the other: "Are you a Peth or a Pank?" Whatever the cause of the break-up of the original leadership, which was supposed to arise out of a divergence of opinion over the newer tactics involved in the destruction of property, Mrs. Ayrton felt, as many others did, that it would weaken the whole suffrage movement. But with her broad views on the subject she found it impossible to be a mere partisan, and she wrote letters to both parties concerned, expressing her belief in the integrity of their motives and her own determination to continue to serve the movement in every way that was open to her. This she certainly did, although it is doubtful if she ever again felt the enthusiasm for the W.S.P.U. that had actuated her until now. For the next eighteen months, the house in Norfolk Square was a nursing home for released suffragettes "out on licence." The passage of the "Cat and Mouse Bill," as it was nicknamed, designed to obviate the alleged necessity for the forcible feeding of suffragist hunger-strikers, meant that every two or three days, up to the outbreak of war, suffragist prisoners were discharged in a state of collapse, to be nursed up by their friends until they were in a fit state to be rearrested—unless, as often happened, they managed to escape meanwhile.

It was no pleasing experience to be the hostess of released hunger-strikers—"mice" as they were called—for it meant that the house was watched day and night by police, who thus attracted Press photographers and reporters, besides loafers of all kinds. A surer method of inviting social ostracism could scarcely have been devised; yet, needless to say, Hertha Ayrton did not hesitate to respond when the request came for

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her help in this direction also. The following letter gives some idea of her experiences; it was written to Mrs. Zangwill in April, 1913, the day before Mrs. Pankhurst's licence expired, on the first occasion that the latter had been released under the new Act:

"You may imagine we have been having lively times here, and we expect livelier to-morrow, though I don't believe for a moment they will dare to take Mrs. P. back to prison, ill as she is. She has not been able to get up at all, and if she even sits up in bed, her nurse makes her lie back at once . . . she is in splendid spirits and game to go back again if they choose to take her. I knew nothing about her coming here till quite late on Monday evening, when they asked me if I would take her. She was worrying over the harm she was doing the nursing home, through the detectives being about and all the excitement of it. I said, of course, I should be only too pleased to have her, and went off then and there to see her and set her mind at rest. . . . She was brought in the ambulance after dark, to avoid the crowds, and carried straight up to bed in the white room; and there she is now. It was horrible to see her being carried upstairs in a long white bed, looking as if it were no living thing that was lying there. She had a white silk handkerchief over her head, and was lying quite still, and it was all ghastly. . . . There are two or more detectives in front, two at the back, one at least on the roof of the nearest empty house; and a taxi waiting to pursue, if Mrs. P. should get up and run away!"

This was the first of many occasions on which Mrs. Pankhurst was brought to Norfolk Square on a stretcher in almost a dying condition, and, her licence having been extended for the purpose, kept there until she was rearrested or had escaped to the country in disguise. It was not only the W.S.P.U. leader, however, who came to Norfolk Square as a "mouse," for many a militant suffragist of the rank and file owed her health, if not her life, to the care and skill with which she was nursed at Norfolk Square. One of these wrote afterwards to her: "It is your wonderful understanding that makes everything you do of such immense value; and it does

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matter, when one comes out of that hell, whether one comes to the right person or not."

In the early summer of 1913, Mrs. Ayrton suffered the additional anxiety of knowing that her daughter, who as a W.S.P.U. organizer was responsible for much of the militancy, was again "wanted" by the police; and one evening she learned that a very young-looking schoolgirl in very short skirts, with a plait down her back, had escaped to France by the night boat. During the seven weeks that Barbie was an exile in foreign parts, her mother made one of her many sacrifices for woman suffrage in the anxiety she suffered; but the danger blew over, probably because the hands of Scotland Yard were too full of birds, or rather mice, to be troubled to catch one in the bush; and Barbie, her hair put up and her skirts lengthened—in those days long skirts were a sign of maturity—returned home again.

Mrs. Ayrton never discussed in public the later tactics of the W.S.P.U.; but that she felt them to be ineffective can be gathered from her more intimate correspondence during this period, though she never sold the pass by criticizing any suffrage society in the presence of the common enemy. In one despondent moment she wrote: "I often think very sadly that perhaps I should have been more useful to the Cause if I had devoted myself to my own special work as Madame Curie has done." But despondency was too foreign to her nature to be lasting, and this passage should be read in conjunction with her instant support of the new suffrage society, called the United Suffragists, which was founded early in 1914 and of which Barbara Gould was the first honorary secretary. This was a society of men and women of all shades of suffrage opinions, and Mrs. Ayrton was intensely interested in its formation and

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gave the first sum of £100 to its funds. She became one of the vice-presidents, together with Professor Caroline Spurgeon, Miss Beatrice Harraden, Sir Ronald Ross, Sir Harry Johnstone, Miss Lena Ashwell, Mr. H. W. Nevinson and many other well-known people.[1]

It has been necessary to dwell at some length on Mrs. Ayrton's connection with the suffrage movement because it had a direct bearing on her life as well as an indirect effect upon her career as a scientist. At the same time, to her contemporaries, and to posterity after her death, she may be said to have been, as a suffragist, only one among others, while as a physicist she stands alone in her special work, and particularly so in her discoveries in connection with water-movement. During the most strenuous political moments of the years immediately preceding the outbreak of war, she still persisted steadily in her scientific researches. There were also lighter intervals when she allowed herself to forget she was either a physicist or a politician; and one of these occurred in August and September, 1912, when Madame Curie and her two young daughters came over to England to spend the summer holidays with her. Mrs. Ayrton had taken a house at Highcliffe-on-Sea in Hampshire; and there, on the edge of the New Forest, and with nothing but a little wood between the garden and the sea shore, it was possible to relax entirely from work and politics. Every one in that house party, except the children, had gone there for forgetfulness, including Madame Curie herself, who was recovering from an

[1] The outbreak of war naturally limited the activities of the United Suffragists, but they may be said to have been largely instrumental in keeping alive the suffrage movement during the years 1914–18, and to have taken a fair share in the final political campaign that secured the inclusion of women in the Representation of the People Act of February, 1918. (See Chapter XIX.)

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illness and wished to pass unnoticed under the *incognito* of Madame Sklodowska, her Polish family name. Her secret was so well preserved (naturally, in a household accustomed to sheltering "mice"!) that no newspaper discovered her presence in England, though she wound up her visit by a short stay in Norfolk Square.

Mrs. Ayrton wanted a rest more than anybody, that summer, but she never seemed to think of herself, or of anything except the happiness of her guests. We were a merry party in spite of many preoccupations: the children saw to that. Irène Curie, the elder, already showed promise of the genius for mathematics one would expect to find in one bearing her name, and it has since led her to follow in her parents' footsteps as a physicist; little Eve, later to become a musician, was then just little Eve, adored by her mother and spoilt by every one else who came under her sway. Looking back and remembering how much trouble and strife still lay ahead of Hertha Ayrton in 1912, one likes to recall those tranquil weeks in the old Mill House at Highcliffe, where she so thoroughly enjoyed the society and congenial companionship of her French colleague. Their friendship was much strengthened by this visit, and also by the few days that Madame Curie spent at Norfolk Square in September, 1913, when she came again to England to attend the meeting of the British Association at Birmingham. Nothing but the war prevented their again passing the summer holidays together in 1914. In a sentence that occurs in one of her letters, Madame Curie very simply but admirably expresses her estimate —so many people's estimate—of Hertha's character. After referring to disillusionments that both have suffered in different ways, she adds: "Mais je vous conserve une grande affection car vous n'êtes pas de ceux dont on se désillusionne."

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Another picture in one's mind of Hertha Ayrton belongs also to this period before the war. Dr. Louisa Garrett Anderson and her friend, the late Dr. Flora Murray, had founded in 1912 the Women's Hospital for Children, in Harrow Road, and Mrs. Ayrton had then consented to become a vice-president of it. When a new wing was added in 1913, in the shape of an in-patients' ward, Mrs. Ayrton presided at the opening ceremony and made one of her few public speeches, explaining that over 6,000 little patients had already been treated there since the hospital was opened, and praising the doctors who ran it for the way the child's interests were studied in this, the first children's hospital to be founded of which the staff was composed entirely of women.

In these years there were occasional literary excursions, too. When her son-in-law, Israel Zangwill, published his play, *The Next Religion*, which had been refused a licence by the censor of plays, Mr. Charles Brookfield (though it was afterwards produced with success by a Sunday dramatic society), Mrs. Ayrton wrote to him with enthusiasm:

"It was very good of you to send me your new play, which I have enjoyed enormously. Mary is fine—so utterly unhackneyed and so subtly right in conception. . . . The last scene is magnificent, but almost too poignant; I don't think I could bear to see it acted. The whole play is full of keen observation and is delightful because it is the view of a man who sees for himself. But then, poor old Brookfield doesn't understand—he wants man, wife, and lover in the usual style, and so he censors you. It is an honour!"

And in February, 1914, she wrote to Mrs. Zangwill, who was unable to come to town for the occasion, the following description of the first performance of her husband's play, *The Melting Pot*, which ran with success in London and the provinces, until, for diplomatic

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reasons connected with our Russian alliance, it was withdrawn during the war:

"I enjoyed *The Melting Pot* enormously; it was very fine and big, and was extremely well acted on the whole. . . . It was very refreshing to have a play with ideals and one that made you realize a little the big dramas that are going on in the world. Mr. Nevinson was immensely impressed; he and Barbie and Gerald came on here for sandwiches and drinks, and we were all agreed as to its being a very great play."

The reference here to the essayist and war correspondent is slightly misleading in its formality; for in that circle Henry W. Nevinson had been known familiarly for some time as the "Grand Duke," a nickname earned by him on his return from Eastern Europe in 1912, when he went straight to spend Christmas with Mr. and Mrs. Zangwill at Far End; On this occasion, with his Russian furs and his name in Russian characters on his suit-case, he excited so much deferential interest on the part of the railway officials, who evidently took him for some important Russian personage, that the Christmas house party, which included Mrs. Ayrton, gave him his ironical title; and, probably by reason of its irony in connection with so uncompromising a democrat, it at once became too popular to be dropped.

There was naturally a good deal of sympathy between two such rebels as Henry W. Nevinson and Hertha Ayrton, although in the matter of science, of which he always professed himself entirely ignorant, they had little in common. But I think she had him in mind when she told Barbara, in 1913, that she thought of speaking at the Women Writers' dinner on "Where Art and Science Meet," because, she added, "their common ground is the imagination, which most people think that science can do without." Mr. Nevinson, in a discussion with her one day, had assumed that there

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could be no place for the imagination in scientific work, a theory she hotly contested. Listening to her views, one gathered that they were more or less those of George Eliot, expressed in that passage in *Daniel Deronda* where the novelist insists that poetry and romance "exist very easily in the same room with the microscope and even in railway carriages; what banishes them is the vacuum in gentleman and lady passengers."

I gathered from their conversation that, as in most arguments between fair-minded and enlightened people, Mrs. Ayrton and Mr. Nevinson were mainly in agreement all the time. That they were greatly in sympathy on many matters and that he thought much of her opinion may be seen in a letter he wrote her, in reply to one of hers praising a book of his—I think *Essays in Rebellion*—in which he says: "After all, a writer's only real reward is to be appreciated by the people who count."

As it turned out, no one ever heard her considered opinion on the fascinating subject of the connection between imagination and science; for the Women Writers' dinner coincided with one of Mrs. Pankhurst's many exits from Holloway Gaol, and Mrs. Ayrton was therefore unable to be present. But she went to another dinner, shortly after, a fancy-dress affair organized by the Women Writers' Suffrage League, at which she appeared very appropriately in the character of Deborah. And about the same time she was the guest of the Royal College of Science at the annual dinner of their Old Students' Association. Perhaps that was why she wrote to Barbara and her husband as to fellow-revellers, when they went away for a holiday: "Take care of yourselves and have the time of your lives; only don't wear yourselves out, because although we are only young once, it is as well to save a little of ourselves for future use!"

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She was the last person, however, to take this excellent advice herself. Among her many public activities at this time must be included her support of the Humanitarian League in its attempt to get flogging as a punishment excluded from the Criminal Law Amendment Bill, then before Parliament; as well as a spirited reply to Sir William Ramsay, who in an unguarded moment told a *Daily Mail* interviewer that "all the eminent women scientists have achieved their best work when collaborating with a male colleague," and who delivered himself further into her hands by instancing the Curies and the Ayrtons in support of this sweeping statement. Hertha's reply was characteristic. After taking up the cudgels, not for the first time, on behalf of Madame Curie, she went on to say of her own work:

"As far as I am concerned, Sir William Ramsay is even more at fault, for all my scientific work has been carried out alone. My husband foresaw that if we collaborated any merit that might attach to our work would be attributed to him . . . and he therefore, out of a chivalrous regard for my scientific reputation, refused ever to collaborate with me. . . . In later days he knew so little of what I was doing on the subject of sand ripples and oscillating water that he saw some of my experiments for the first time when I showed them in public."

She further pointed out that "it is apparently not a womanly but a human characteristic" to collaborate with some one else, and concluded with a sly thrust that can scarcely have been resented:

"In testifying to the stimulus provided by collaboration, Sir William Ramsay speaks from a wide experience denied to me; for most of his own work has been done 'when collaborating with a male colleague,' and one can imagine the fervour with which he worked 'with Lord Rayleigh and for Lord Rayleigh' at the discovery of argon."

For some months before the outbreak of war, Mrs. Ayrton was occupied in making fresh investigations

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into electric arc carbons. It will be remembered that up to the year 1910 she had been engaged in making experiments for the improvement of carbons used in searchlights; so it was natural that one of the large cinematograph companies, aware of her reputation, should have commissioned her to find a new carbon specification capable of producing a steady arc for cinema lighting. At that period, the lighting of cinemas was still very defective, as the searchlight had been, owing to the erratic behaviour of the electric arc. Mrs. Ayrton accepted this new commission and worked for some months in a laboratory at Strawberry Hill, finally producing a carbon which she patented in 1913, and which was used to great advantage in cinema lighting. Briefly, it may be said that she turned the negative carbon inside out, and invented a small-diameter negative carbon with a relatively slow-burning core, a quicker-burning shell, and an outer film of copper of such a thickness as to volatilize away from the arc and keep the tip of the carbon so shaped as to ensure the quick and steady burning of the arc. This was the exact reverse of the negative carbons previously used in arc lights, which had been characterized by a quick-burning core and a slower-burning shell. The value of her new carbon specification in film production will be obvious to all who remember how, in the early days of the picture palace, films used to blink and flicker owing to the unsteadiness of the electric arc maintained by the older type of carbon.

She had executed her commission for the cinematograph company and was resuming her experiments in water movements, when the catastrophe of August 4, 1914, burst upon the world.

Like so many of her compatriots, Mrs. Ayrton had allowed her political interest to concentrate during

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1913 and 1914 upon the two struggles for freedom that were then being waged against the British Government, the women's fight for enfranchisement and Ireland's fight for Home Rule. Her interest in Ireland, apart from her natural impulse to champion any oppressed section of the human race, dated from her girlhood, when she met Dr. John Dillon and Mr. J. R. Green, and others who were keenly concerned in the cause of Ireland; and her interest was kept alive by her friendship with Mrs. J. R. Green. So her eyes had not been turned towards Europe, where the larger war was brewing; and she allowed to go unheeded the very significant question that Madame Curie put to her in a letter, written in February, 1913, eighteen months before war actually broke out. "Que pense-t-on en Angleterre de la guerre en Europe?" she had asked. "Pense-t-on qu'il y aura une guerre générale?" Nor did Hertha respond with any vigour to another letter dated May 1, 1913, in which Madame Curie, while commenting on the suffrage agitation in England, once more addresses her preoccupied English friend in a strain which shows how the shadow of war was already falling darkly over the Continent:

"Je suis très touchée par tout ce que vous me dites au sujet de la lutte politique qui vous absorbe en ce moment. Je comprends très bien que vous soyez toute à cette œuvre de justice et que vous ne puissiez songer à d'autres préoccupations. D'ailleurs, nous vivons à une époque où le menace de guerre internationale est constamment suspendue sur nos têtes, et si on en vient là, il faudra bien laisser de côté la science pour ne plus penser qu'aux intérêts nationaux les plus directs. Pourtant il est dur de penser qu'après tant de siècles de développement, la race humaine ne sache encore résoudre les difficultés autrement que par la violence."

When war was declared, one of Hertha Ayrton's first thoughts was for her friend in Paris, so dangerously near the war zone in the early days of August, 1914;

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and she wrote off to her as follows, without delay:

"MY VERY DEAR MARIE,—I don't know how to reach you, but I am sending this to Paris, hoping it may get through to you soon. First I want to say that if you would feel your daughters were safer in England, I should be very glad to have them at Norfolk Square, and Eve could go to a day school and Irène to Bedford College for a term. If you would come too, you know how I would welcome you. I take it for granted you will not leave them and come to me for a little while, as you promised to try to do; but if they are safe with friends and you could still do that, or if you would come with them just to bring them, well, you know how much I should like it. Do send me a line if this reaches you, just to say how you are and what you intend to do. I won't write about this horrible war because I am sure we agree about it, and the horror of it is too great to contemplate. . . . Yours always most affectionately, HERTHA."

Madame Curie could not, however, leave Paris, and she decided to keep her daughters with her, the elder of whom soon found war work to do in a hospital, and afterwards in the laboratory as her mother's assistant. Early in 1915 we find Madame Curie writing to Hertha a description of her own contribution to the saving of life, in what she calls "ce temps de cauchemar," telling her how she was equipping motor ambulances with X-ray apparatus for use in the French and the Belgian lines. As a result of her appeal for financial help, Mrs. Ayrton helped her with the equipment of a travelling X-ray car for the Scottish Women's Hospital, to operate in France between Troyes and Royaumont, under the French military authorities. "Ma chère amie," writes Madame Curie, in June, 1915, overwhelmed in the midst of her humane work by the magnitude of the tragedy, and especially by the sufferings of Poland, the land of her birth: "Que tout cela est donc triste à voir pour nous qui croyions à une humanité paisible et fraternelle!"

But, before she received this last letter, Hertha

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was herself absorbed in the life-saving invention by which her name became known to thousands of soldiers on the battlefields of Europe; and henceforth, until the end of the war, the two friends had no time for correspondence.

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CHAPTER XVIII

THE AYRTON FAN (1915–18)

In common with many capable women, Mrs. Ayrton found little work of public utility to do when war first broke out, the capacities of women outside the home being naturally obscured in the vision of a Government whose favourite argument against woman suffrage had been the contention that women took no part in war and therefore had no right to a voice in deciding issues of peace and war. Immediate revision of these pre-war standards could not be expected; and intelligent women, not content with permission to "shop as usual" and to "keep the home fires burning," had in consequence to overcome perpetual opposition, in the early days of 1914–15, if they wanted seriously to help their country. Mrs. Ayrton answered every call that was made upon her; but having subscribed to war charities, responded to appeals for Y.W.C.A. hostels, and joined in protests against the low rate of wages paid to women in emergency work-rooms, she still found herself at leisure to complete her paper on "The Local Differences of Pressure near an Obstacle in Oscillating Water."[1]

In this paper she concentrated entirely on the experiments she had made in order to meet the objections put forward by certain critics in the Royal Society to some of the conclusions contained in her 1904 paper

[1] *Proceedings of the Royal Society*, A, Vol. 91, 1915.

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on ripple mark, which had been published in 1910, and also in her 1911 paper which had not been accepted.[1] Lord Rayleigh himself undertook the formality of "communicating" this new paper to the Royal Society, which was a strong indication that in it she had refuted the criticisms in question; for he was one of the original sceptics, though he had shown himself always to be a broad-minded, chivalrous critic, ready to be convinced. Doubtless, Mrs. Ayrton had in her mind the debt she owed to Lord Rayleigh for his support on this occasion, when she wrote afterwards to Mr. Greenslade, on reading the announcement in *The Times* of Lord Rayleigh's death (July, 1919): "He was one of the really honest men of science, and extremely modest in spite of his real greatness."

She read her paper before the Society on May 6, 1915, and in the experiments that illustrated it she used her new pressure-indicators, made by her own fingers with infinite care and skill after many models had been tried and rejected. She claimed that these were free from the objection urged against the pressure-indicators used in her former experiments—namely, that the water inside the gutta-percha diaphragms then employed might itself cause variations in the distribution of water pressure on which her conclusions were founded. After demonstrating by new experiments that her claim was justified, she submitted that the conclusions originally arrived at, with regard to ripple-forming vortices, were now established.

That her audience admitted her claim is seen in the acceptance and publication of this 1915 paper by the Royal Society. But, satisfactory as this culmination of many years of labour must have seemed to her when she went away from the lecture-hall, that after-

[1] See Chapters XIII and XVI.

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noon in May, the immediate outcome of the work was so much greater in its effect that the ultimate scientific value of her paper was completely overshadowed "for the duration of the war."

To the maid who opened the door to her, on her return to Norfolk Square, she said that she wished to be left undisturbed in her laboratory for the rest of the day: an idea had come to her during her drive back in the taxi that she wished to pursue at once, for it might mean the saving of numbers of lives at the Front. Simply put, the idea that had flashed upon her was that of applying what she had discovered about currents and vortices in water to the repulsion in the air of clouds of poison gas. She argued that, since the continuous movement of waves in water had been proved by her to produce certain vortices in each wave-length, the process might conceivably be reversed and the vortices created in order to produce the continuous waves; and from this she went on to apply the same principle to air instead of water, and then argued that the creation of the vortices in air (supposing that some means could be found of doing this) should logically result in the formation of steady waves of air that could be used both to roll up into spiral vortices the oncoming waves of poison gas and so to push back the gas, and also to supply fresh air in the place of these gas waves.

This inspiration, which came to her just after the first use of gas by the enemy on the Western Front, was the germ of her invention of a portable fan or flapper, which, beaten in a certain way on the parapet, wall or floor of a trench or dug-out, stirred up the necessary vortices and set in motion the whole process anticipated by her. She conceived her invention first as a fan revolving rapidly on its own axis; and, in a statement that appeared over her signature in *The Times*,

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after the war (May 3, 1920), she described how she arrived at her final contrivance, a fan that did not revolve but, hinged on a stick, had to be beaten against something firm:

"On May 6, 1915, I conceived the idea that it might be possible for our men to drive off poisonous gases and bring in fresh air from behind by simply giving impulses to the air with hand fans. By May 14, I had made a small model, giving surprisingly good results, and I wrote to the only authority at the War Office I knew at all, to offer it to the army, if experiments in the open confirmed those of the laboratory. A few days later, I much improved the fan, by recalling the violence and extent of the air currents set up upon my accidentally dropping one end of a small tank on a table strewn with a light powder. 'A beating movement will solve my problem,' I thought, and, as a first experiment, I beat with a post-card on a table on which heavy smoke was rolling. The result was so astonishing that I laughed aloud at the simplicity of the solution; but that very simplicity was its undoing. 'You cannot expect any one to believe it who has not seen it,' every one said. And no one did."

She was right when she said that the simplicity of her invention was its undoing. One must further take into consideration the want of sympathy in the traditional attitude towards one another of the chemist and the physicist; and, unfortunately, the scientific advisers of the Government, to whom she had to submit her invention, were all chemists. And thirdly, there was the general failure of the War Office, as *The Times* pointed out in its editorial comment upon her statement after the war, to make adequate use of science in warfare; and this was shown, doubtless, in other directions than in their treatment of the Ayrton fan. Another newspaper, which commented at the same time on the way this and other war inventions had been "sniffed at" by high officials, added ironically: "There appear to have been far too many of these sniffing individuals, who seem to have had nothing much else

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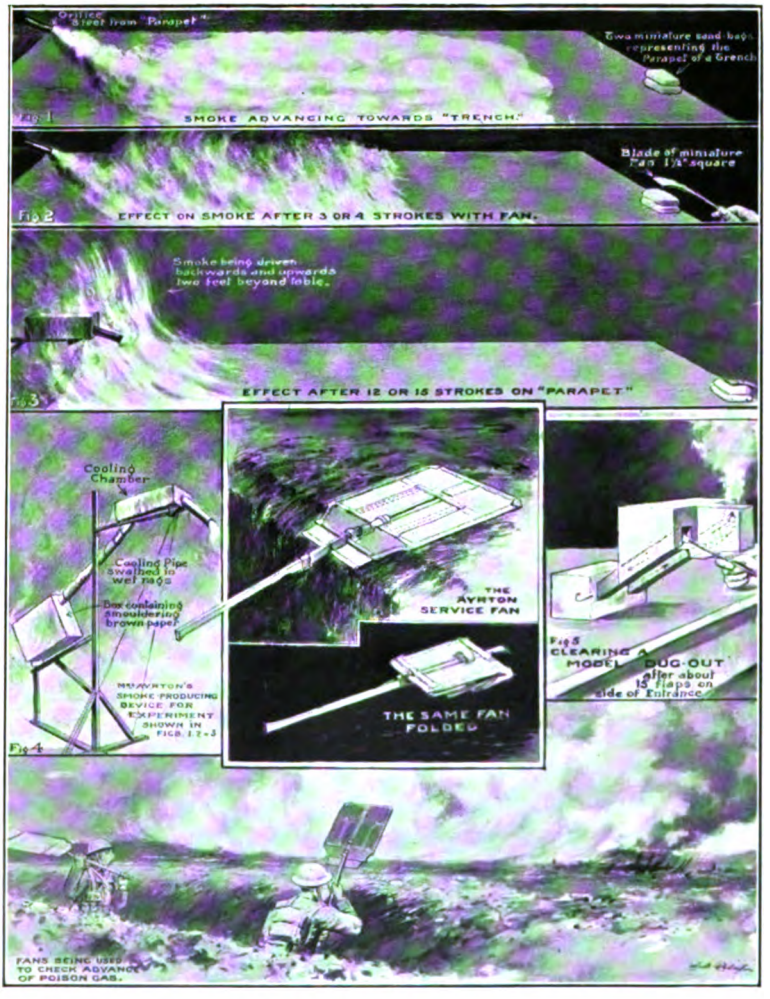
Orifice 6 feet from "Parapet"
Two miniature sand-bags representing the Parapet of a Trench
Fig 1
SMOKE ADVANCING TOWARDS "TRENCH."
Blade of miniature Fan 1½" square
Fig 2
EFFECT ON SMOKE AFTER 3 OR 4 STROKES WITH FAN.
Smoke being driven backwards and upwards two feet beyond table.
Fig 3
EFFECT AFTER 12 OR 15 STROKES ON "PARAPET."
Cooling Chamber
Cooling Pipe swathed in wet rags
Box containing Ammonium brown paper
MR AYRTON'S SMOKE PRODUCING DEVICE FOR EXPERIMENT SHOWN IN FIGS. 1, 2 + 3
Fig 4
THE AYRTON SERVICE FAN
THE SAME FAN FOLDED
Fig 5
CLEARING A DUG-OUT
MODEL
after about 15 flaps on side of Entrance
FANS BEING USED TO CHECK ADVANCE OF POISON GAS.

THE AYRTON ANTI-GAS FAN

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in their heads but colds." In any case, many as the excuses are that can be reasonably advanced for official preoccupation during a world-war, this combination of obstacles against which Hertha Ayrton had to struggle, and—for the sake of the men who were being gassed in thousands at the Front—did struggle with what Mrs. J. R. Green called a "splendid courage and patience," brought about a delay of a whole year before the fans were used at the Front at all, and, more serious still, caused them to be finally sent out in insufficient numbers and often supplied to the soldiers unaccompanied by the necessary instructions for their use.

Simple as the Ayrton fan or flapper undoubtedly was in one sense, its simplicity was of the kind to which Whistler pleaded guilty when, on being asked if he had really taken only a few hours to paint a picture for which he demanded what was thought an exorbitant price, he replied: "It has taken me my whole life to paint that picture." And Hertha Ayrton, who had spent years of her life discovering the full application of the principle of physics on which her war invention was based, might have made the same reply to those scientific and military critics who seemed to think that such an apparently simple device as a fan was beneath their notice in the fog of war. She might have made Whistler's reply, for instance, to the famous chemist engaged on Government work, who was always too busy to let her show him her fan in working, but was quite satisfied, without seeing it, that "fans were not required at the Front, as the gas was well in hand"—an optimistic statement that he made, as it happened, just a few days before news came of the terrible casualties from gassing at Loos. Or she might have made it equally to the military authority detailed to assist her in some open-air trials, who gave it as his "humble

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opinion that the fans were not a military proposition," an objection, however literally true, that made her say rather bitterly to me, one day: "I suppose, if I had invented something to destroy life instead of saving it, it would get taken up at once as a military proposition!"

Twice her son-in-law, Israel Zangwill, came to her aid by appealing personally to Mr. Lloyd George. On the first occasion (May 28, 1915), though Mr. Lloyd George, then Minister of Munitions, was unable to see her himself, he deputed Dr. Addison to do so instead, with the immediate result that she was passed on to the proper military authorities. But even with this high official aid, the necessary tests at Chatham were not carried out until the following September. She spent the intervening period, when not occupied in trying to move officialism, in continuing her experiments with different-sized fans—the first one she constructed was the size of three postage stamps, the tiny hinges being made of glove kid—and in developing their usefulness. Her first open-air experiments were made in the garden of Dr. Herbert Mills, of Kensington, whose wife, Tina, has already been mentioned. By their friendly aid a trench was improvised and the fan tested with clouds of brown-paper smoke. "Without the experiments in your garden I should still be uncertain about the effects in the open," Mrs. Ayrton wrote gratefully to them when at last the scene of the tests was removed to Chatham.

All kinds of people came to see the fan operating in her laboratory, while she was waiting for the military authorities to move, and among them Professor Armstrong, once her opponent in another field, who was much impressed by what he saw and afterwards helped the Chatham people by telling them of an innocuous gas that could be used in the experiments. A well-

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known K.C., who was also a man of science, came and murmured "Magic, magic!" when he saw the smoke sent rolling back by the action of the small and insignificant-looking fan; and "magic" was the word most constantly applied to it by those who came to her laboratory as sceptics and went away enthusiastic converts to its powers. Among these visitors none was more helpful than Mrs. J. R. Green, and it was through her that Sir Lauder Brunton came, who afterwards wrote to Sir Douglas Haig and was instrumental in getting the fan sent to France to be tested. General Sir Edward Bethune was equally impressed and brought it to the notice of Sir John French.

Among several officers home on leave, who came to her laboratory at this time, was Captain (afterwards Major) H. J. Gillespie, R.F.A., known to Mrs. Ayrton before the war as a good suffragist, who had experienced gas attacks at the Front and was less confident than the advisers of the War Office that they could always be combated with sprayers and respirators. He took a fan back with him to France, where he successfully demonstrated with it to the "Gas Expert, 1st Army," who reported favourably on it to the Experiments Committee. Captain Gillespie was well aware of the importance of beating the fan in a certain way in order to set up the air vortices—a perfectly easy way, only it had to be acquired—and he made representations to G.H.Q., to the effect that he was the only man over there with the requisite knowledge and would therefore like to be present at the official trials in France. Unfortunately, again in the fog of war, his representations were overlooked or forgotten, and after a test that was consequently not a real test, the Experiments Committee not unnaturally rejected the fan.

The report issued at home, in September, 1915, by

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General Sir Rainsford-Hannay, Commandant at Chatham, was, however, extremely favourable. Like many others, the Commandant had been sceptical when first approached, but being open-minded, intelligent and conscientious, he gave the fan a fair trial, welcoming Mrs. Ayrton's co-operation throughout. After observing that "one naturally approaches this subject with the idea that there can be nothing in it of any practical value," he went on in his report to admit frankly that, "after seeing the trials, every one has been converted to a contrary opinion." Stress was laid upon the fact that "a small amount of instruction is required in the use of the fans," and therefore it was recommended that Mr. Greenslade, Mrs. Ayrton's assistant, should go out to France "to undertake preliminary instruction." The report concluded with the emphatic words: "I feel sure that any one who has seen what these simple expedients can do would not be satisfied to go to the trenches without one of the fans."

Unfortunately, very large numbers of men were still suffered to go to the trenches without the Ayrton fan; for after the issue of the Chatham report, the inventor had again to work untiringly in order to get the War Office to move in the matter. "If it were not that so many lives were at stake, I should be strongly tempted to give up the whole thing and settle down to write a paper about it," she wrote in a moment of despair to Mr. Greenslade; and in a letter to Mrs. Zangwill, she said:

"After all, I am only asking that a thing which promises so much shall be given a fair trial. I don't want it used unless it is going to do its business. Why then this difficulty?"

Her friend Mrs. Green was better acquainted with the ways of Government departments. "I believe no letter is answered at any great Office under a fortnight," she

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wrote in gentle irony; "the war leaves their grand routine unchanged. There would be no need for conscription if they did their business and stopped wasting lives. When there are no more men to be wasted, perhaps they will look to business." Mr. Zangwill, also versed in the ways of officialism, made another personal appeal to Mr. Lloyd George in the interests of the men at the Front, and secured a promise of "assistance," to which he replied satirically:

"While I am grateful for the kind tone of your letter, I do not understand what you mean by 'assisting' me. It is I that am trying to assist the country in face of the lethargy, the incredible lethargy till yesterday, of the War Office."

The lethargy was broken down temporarily by the dispatch of Mr. Greenslade to France in January, 1916; and as a result of this move, the fans were properly tested over there, and G.H.Q. (not the Experiments Committee) issued a report dealing with the two uses of the fan: (1) to drive back gas sent over in clouds, and (2) to clear trenches and dug-outs of gas left behind, after shelling with gas had taken place. With regard to the first point, the G.H.Q. report affirmed that the fan was not sufficiently powerful to make any marked effect against a gas cloud coming in winds of a velocity of nine to fourteen miles an hour. It was not tried against winds coming less than nine miles an hour, in which it had been proved effectual in the home trials, and in which the Germans had originally sent their gas clouds. Mrs. Ayrton was left unhappily conscious that, had her invention been adopted when she first offered it, and when the gas had been sent over in winds of a lower velocity, many lives might have been saved by it; but she was ready to concur in the judgment of those who rejected the fan as far as this use of it was concerned, more especially as a change had come over the gas

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situation at the Front by this time, and the enemy had almost given up gas clouds in favour of gas shells.

With regard to the second point, the report was emphatically favourable. Attention was called to "the obvious usefulness of the fans for the secondary purpose of clearing trenches and dug-outs after the gas cloud has passed"; it was stated that for clearing these places after gas shelling had taken place, "the fans on a time basis were approximately twice as efficient as the sprayers"—sprayers being at that time solely used for this purpose; and the report concluded by saying definitely: "We believe it would be wise to place an order forthwith for as many of these fans as there are sprayers at present in use."

This report, if it meant anything at all, meant that suffering could be abated, lives saved and military efficiency increased, by a simple device weighing a few ounces, that could be carried under a soldier's pack and applied without a moment's delay in such a way as to get rid of the noxious gases that sometimes lurked for days in trenches and dug-outs after a gas attack. Trenches abandoned by the enemy could be occupied far more rapidly than was usually the case, the only possible alternatives being sprayers, placed second to the fans in the report, and, later in the war, by fires, which depended upon a supply of dry wood and paper, not by any means always available. In spite of the report, more delay ensued, however, before the fans were sent out;—"and meanwhile, we are losing, losing, losing!" wrote Mrs. Ayrton to Mr. Greenslade. At last, in May, 1916, a whole year after the invention was first offered, an instalment of 5,000 fans was dispatched to France, and Mr. Greenslade went with them to give the necessary instructions for their use.

"Glory Hallelujah!" wrote Hertha to Edith Zangwill,

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when the news came; and congratulations rained upon her. "It must be a satisfaction to you after all your trouble," wrote General Sir Rainsford-Hannay. Mrs. J. R. Green's letter gave her special pleasure because of its allusion to woman suffrage:

"And now I do hope that you will have your rest cure, repose of mind and a sense of public service done. The sunshine must come for good and give you new life for new work. You have done the only 'inventive' work of original thought that any woman here has done for the war, and that is a fine position and will further the other cause you have at heart. So forget vexations and take fresh heart—a braver one you could not take."

But for people like Hertha Ayrton there is never a rest cure in this world. It was not many months before she made the disappointing discovery that neither the supply of fans nor the accompanying instruction (after Mr. Greenslade's return to England) had been adequate. Though she was told by one official, over the telephone, that hundreds of thousands of the fans were already sent out, she calculated later, from figures supplied after the war by the War Office, that the fans were supplied on a basis of one fan for an area two miles long and nine yards wide, only 104,000 having been supplied in two-and-a-half years for the use of five million men. "You might as well try to sweep all the houses from Park Lane to Chancery Lane with one broom!" cried the woman in her, scornfully; and she added that if millions had been sent out, as they should have been, each million would have cost no more than the price of one hour of the war.

But the indifferent manner of their use was the more serious matter. In the training schools over here, all that seemed to be known about them in 1917 was derived from a brief allusion in an Army pamphlet on *Defence against Gas*. Mr. Greenslade himself demon-

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strated the efficacy of the fan when used in the proper manner, on the day that he cleared a practice dug-out of gas, alone and without a respirator, during his flying visit to France in 1916. The dug-out was filled by the deadly method of landing a cylinder of gas in it and turning on the tap, causing a high concentration of gas so dangerous that not a man would follow him into the dug-out, even wearing a gas-mask. He walked right through the dug-out, pushing the gas before him and clearing it out in a few minutes with an Ayrton fan, and was surprised on emerging at the other end to find a crowd of men waiting to see if he would come out alive.

It is not difficult to understand how the fans were voted useless by men who were not taught how to use them. Left uninstructed, they naturally flapped the fans about in the air and failed thus to discover their value, probably thinking them as trivial and absurd as they appeared to a Major in the Royal Engineers, who boasted in a letter to *The Times* that the fan was only welcome in the line "because the handle, being made of wood, afforded valuable fuel." Fortunately, against such frivolous evidence can be set the considered testimony of others, who, because by some lucky accident they possessed both the fans and a knowledge of the way to use them, were able to speak warmly in their praise. Major Gillespie, R.F.A., D.S.O., wrote to *The Times* in contradiction of the letter just quoted, and in defence of Mrs. Ayrton's own statements:

"As to the efficacy of the fans when properly used, Mrs. Ayrton has already quoted a letter from me on the subject [1] written during

[1] The letter mentioned was written from France by Major Gillespie to a friend, on August 7, 1917, and contained the following passage: "I attribute the escape of the battery during the gas bombardment very largely to Mrs. Ayrton's fans. We were all in cellars at the time which we had not had time to render gas-

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a terrific gas bombardment of Armentières in the summer of 1917, when the 57th Division (I think) lost so many men from the effects of gas. My battery escaped without a casualty, although it was in the very hottest corner of the town. In the gasworks behind me (within 100 yards) was a howitzer battery. This is what Major A. Hamilton Gibbs writes of that battery in his book, *The Grey Wave*: 'The howitzer battery behind us had been reinforced with 90 men and two officers the day before the show started. After that first night, one officer was left. He had been up a chimney O.P. all night.' And yet the authorities were quite satisfied at the Front with the masks and helmets and sprayers!"

There was evidence, too, that if the home instruction was faulty where the fans were concerned, in some portions of the war area they were widely and correctly used. After the war was over, an unexpected testimonial to their efficacy came from "Patlander," author under this pseudonym of the war series in *Punch* entitled "The Mud Larks," in one chapter of which he wrote (June 18, 1919), after commenting on the many portraits of war celebrities that were appearing in the daily Press at the time:

"But what of our other benefactors, the names of whom are far more familiar to the average Atkins than are those of the Twelve Apostles or his own Generals? I confess to a great desire to behold the features of Mr. Mills the bombster . . . Mr. Stokes of the gun, Mrs. Ayrton of the fan. . . ."

Mrs. Ayrton wrote to thank him for his mention of her fan, and he at once replied with:

"It is I who thank you, not you me; many and many an obnoxious perfume have I flapped over the parapet with your

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proof in the orthodox manner. The affair lasted something over three hours on the first occasion, but we organized gangs of flappers, and after that time, when the 'snowstorm' eased up a bit, we were able to take off our masks without any subsequent bad effects. The gas hung about for days afterwards, but by judicious flapping at frequent intervals we managed to keep our quarters fairly free from it."

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invention. My only surprise is that your name has not been made the subject of public praise over and over again. Anyhow, there are thousands and thousands of inarticulate soldier persons who are extremely grateful to you. . . . I hope the show at the Royal Society went off well, and I'm sure it did; but to see your fan at its best was to see it in a front-line trench dealing with a cloud of mixed phosgene and chlorine—a state of affairs I devoutly trust it will never be called on to handle again."

The same witness, an officer in a cavalry regiment during the war, described in a further letter a demonstration in which he had taken part, conducted by British gas instructors in an Italian military school at Padua:

"We manned a system of trenches and were subjected to three or four waves of mixed gases (phosgene, chlorine and lachrymatory) one after the other. We were provided with Ayrton fans (three, I think, between traverses) and told to clear the trenches between each wave. This was done every time, the trenches being cleared absolutely so that respirators could be taken off. I can speak with absolute certainty in this because I was responsible for the clearing, and it was done entirely with Ayrton fans, and not a single man was any the worse for it. . . . The instructors at the Italian school (who were very capable fellows with considerable experience of the Western Front) insisted on the use of your fan in clearing trenches. . . ."

Such letters would have had double their value had they reached the inventor of the fan during the war. For, at the time, all that seemed apparent to her was, as she wrote to Mrs. Zangwill in August, 1918, that:

"after all, the poor soldiers are little better off for all my work. . . . Of course, I shall not give up; but I don't know what steps to take next, and I am so weary of fighting that all except one little bit of me says 'Give it up.' But the little bit won't let me."

The "little bit" that persisted must have been rewarded to some extent; for there is little doubt that she would have won her point handsomely and the Ayrton fan would have been both widely distributed and properly applied, if hostilities had not ceased just as

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this happy culmination of all her efforts was in sight. Admiral Bacon, of the Munitions Inventions Department, proved a staunch and intelligent ally when she went to him with her model of a mechanical double fan, at which she was working for the last eighteen months of the war. "The Munitions people are now all that I could desire," she wrote to Israel Zangwill, "and are working hard at the drawings of my double fan, which is to be made at once: they are themselves deeply interested in it."

In further confirmation of her growing reputation with the authorities, she was asked to make an investigation for the purpose of applying her invention to the ventilation of machine-gun emplacements—"pill-boxes," as they were called—and was actually engaged on this unpleasant and difficult task when the war came to an end. Mr. Greenslade tells of the astonishment of the officer in command, when, having conducted Mrs. Ayrton to the test pill-box in Kensington Gardens, the entrance to which was a small square opening below the surface of the very muddy ground, he saw her without the smallest hesitation go down on her hands and knees and crawl into it. Certainly, no other practical work undertaken by her was so physically exhausting as the hours she spent daily, for some weeks, experimenting in these dark, ill-ventilated, confined spaces.

Other signs of tardy recognition were seen in the approaches made to her by the French Munitions Department, and by Mr. Page, the American Ambassador (the latter at Mr. Zangwill's suggestion) on behalf of the American Forces, with a view to the adoption of her anti-gas fans. And although all Colonel Wedgwood's gallant attempts in the House of Commons to get the Secretary of War to push the effective use of her invention in our own Forces seemed ineffectual—"Mr.

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Macpherson is willing enough," he wrote to her, "but the machine seems too heavy to move"—other evidences were not wanting that the fans were making their own reputation in the Army. By the middle of 1918, military instructors in this country were beginning to make inquiries about them on their own account, and among such inquiries as came indirectly to Mrs. Ayrton was the following rather ironic letter from an A.S.C. instructor, written to a friend of hers with a request that one of the fans might be sent by the inventor direct to the A.S.C. barracks at Woolwich, for teaching purposes:

"They say they do not issue them to the above corps, and that sandbags would do for instructing purposes. As an instructor I have found it useful to stretch a man's imagination a little, but I cannot tackle the job of getting a man to imagine that a sandbag is anything like an anti-gas fan. I trust you will do all you possibly can for me in this case, as a man cannot be taught too much in the ways of protecting himself and others against gas when over on the other side. . . ."

Hertha Ayrton, to whom the war was always as much of a "nightmare" as it was to Madame Curie, was not likely to regret that the final triumph of her invention should have been forestalled by the cessation of hostilities. Still, it must have added to her sense of the futility of mortal effort to reflect that it was only when the Armistice was imminent, that our Allies abroad, and the Munitions Inventions Department at home, had alike become as interested in her invention as in her innocence she had expected the War Office to be, when she first placed it at their disposal three years and a half earlier. No doubt, from the official point of view, it was highly unreasonable of her to expect the "machine" to move more quickly than it did; and, no doubt, many another inventor was treated as badly as she was during the war period. But her answer to this might reason-

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ably have been that she was already sufficiently known as a physicist to merit rather more consideration than many of the unknown inventors who besieged official departments at that busy time, though I do not think she would have advanced that argument. In her simplicity, she was unable to admit any excuse of any kind for delay when the saving of life was in question; and she could never understand why she was submitted to as much discouragement and obstruction as if she had been haggling over a high price for her invention, instead of offering it, free and unconditionally, for the period of the war. Perhaps, her utter disinterestedness with regard to the commercial value of her invention stood, like its apparent simplicity, in the way of its being valued by authorities who were unaccustomed either to simplicity in war inventions or to disinterestedness in the inventor.

Her experiences remind one irresistibly of Daniel Doyce in *Little Dorrit*, who, because he had "spent a dozen years of his life in perfecting an invention of great importance to his country," was treated by the Circumlocution Office, "from that moment, as a man who had done some infernal action." Like him, Hertha Ayrton might have said: "I have frequently found it necessary to reflect, for my own self-support, that I really had not done anything to bring myself into the Newgate calendar, but only wanted to effect a great saving and a great improvement."

I do not know if she made such philosophical reflections for her own self-support; but I do know something of the anguish of mind and spirit that she suffered through the dilatoriness, and in some cases the apparent hostility, of those she had to deal with, in her perfectly rational attempt to get this life-saving device, first fairly tested, and afterwards, fairly employed. Perhaps

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her lack of the armour of indifference that is put on by the children of this world was her defect, throughout her contest with Government departments. But, as this account of her life should have already shown, Hertha Ayrton was incapable of indifference. She might be called unreasonable by those of whom she foolishly expected that they should see reason, or persistent to the point of tactless aggression by those who wanted only to be let alone; but her worst enemy could not have called her indifferent. Just as she had scorned half-measures in her championship of militant suffrage, so in advocating the use of the Ayrton fan, believing it, and justifiably so, to be a means of preventing suffering and saving lives, she felt that her own life and convenience, or anybody else's convenience, did not enter into the matter at all. Health, time, knowledge, money, personal popularity—everything she had to give was poured out with both hands, with no more regard for future needs than for her present ease and comfort. When they offered her some minor decoration that was being handed out by the dozen to war workers, she refused it and told no one beyond her immediate circle of the paltry offer—less from a sense of its paltriness, however, than because, as she once told me, she thought all such honours invidious, as suggesting comparisons in real worth that Governments, least of all war Governments, could not be trusted to make.

What mattered primarily to her, all that terrible time, was that men and boys were coughing their lives out in the trenches when she believed confidently they might have been saved by her fans; and the pain that this brought to her was never forgotten or lived down. A lesser nature might have been crushed by it; even she could not escape being worn out beyond recovery and inexpressibly saddened by it. She was never physically

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strong again, and never really lighthearted again, though she kept her courage and her fundamental belief in humanity to the end; and fortunately, much quiet happiness was still in store for her in the five years to come. But she needed all her natural buoyancy in order to take up her life again, when the battle was over; and her tendency to withdraw into herself—like all natures strong in vitality hers needed much solitude, and she did not know the meaning of dulness when alone—became more marked towards the end of her life. "I suppose it is bad for me to live so much alone," she wrote once to her daughter, when some callers had disturbed her, in the autumn of 1918, "because it makes me so intolerant of chatter and gossip, of letting out one's feelings by talk. I feel myself getting more and more dumb, which is quite inhuman and to be fought against."

Of course she did fight against it, and of course she never became inhuman. But her three years' experience of the Circumlocution Office left their indelible mark upon her.

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CHAPTER XIX

THE WAR PERIOD—AND AFTER (1915–20)

"I am not a private person any more," wrote Hertha Ayrton in 1915, refusing a week-end invitation to Far End. But even when she appeared to be most entangled in the official web, she rarely neglected her personal obligations. At the end of 1915, when the success of the fan tests in France depended largely upon Mr. Greenslade's presence there, she heard that he was ill in Ireland and wrote instantly to urge him not to jeopardize his health by travelling too soon; and again, in 1918, when she was equally anxious that he should superintend the trials of her mechanical fan at the Front, she acted once more as though his welfare were the first consideration—a consideration she never showed to herself. "Anyway, you must not be sacrificed, all the more because you have given so generously of your time and energy already," she wrote to him at Cork. To Barbie, she wrote of Mr. Greenslade, in 1916, that:

"No trouble is too much for him; he is as proud and pleased as if he were my son. He will come at any time and stay as long as I want and work like a Trojan, day in and day out, without fee or reward."

Nor did she fail to respond if somebody in whom she was interested demanded her appreciative attention during the fan period. She found time to congratulate Mrs. J. R. Green, in December, 1916, on the completion of her historical task—the editing, first, of her husband's

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illustrated *Short History of the English People*, in four volumes, and secondly, its issue in one volume with her own epilogue of social and political history, carrying on the narrative from 1815 to 1914; and Mrs. Green wrote warmly in reply, expressing her appreciation of "the affection and gratitude" shown in her friend's letter. Another letter of Mrs. Ayrton's, written to Mrs. Zangwill (April 22, 1918) in praise of her novel, *The Rise of a Star*, indicates that there were moments of peace even in those years of unrest, besides showing incidentally that Hertha never outgrew her youthful pleasure in reading fiction. She wrote:

"I have been spending a long and restful day, sitting over the laboratory fire, reading your novel and enjoying every bit of it. I do congratulate you on having written a fine novel, full of insight and with neither unpleasant problems nor war in it, thank goodness!"

To the end of her life she never learned to care for the introspective self-analytical novel, and she always retained her appreciation for a good plot, not even to the exclusion of the detective story. It was probably her sense of the importance of incident in a story that made her so great an admirer of Dickens, whose novels she read and re-read in her later years as often as those of Thackeray, whom, as a girl, she had ranked higher than Dickens; and it was a curious mark of inconsistency in her that she thought on the whole more of Charlotte Brontë than of the more skilful weaver of plots, George Eliot. In fiction, Hertha Ayrton's taste was far less obviously "modern" than might have been expected in one who, as an interviewer once said in a picturesque reference to her two sons-in-law, was "hyphened to literature."

All these were small matters in comparison with her interest in the great advance that was made in the

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position of women during the war. She was naturally one of the first to rejoice when the Royal Astronomical Society took the enlightened step, in 1915, of securing a supplemental Charter, thus making women eligible as Fellows of the Society; though this example was unfortunately not followed by the Royal Society, or Hertha Ayrton as a Hughes medallist would almost certainly have written "F.R.S." after her name before she died.

This event was followed in February, 1918, by the much greater and more belated reform for which she had personally sacrificed so much; and Mrs. Ayrton was to be found taking part in all the suffragist rejoicings that followed the passage into law of the Representation of the People Act, which enfranchised some six million women over the age of thirty. The war had intervened to calm the passions that once ran so high in the suffrage movement; but Hertha Ayrton was not of those who easily forget, and while she gave due value to the contention, so comforting to the pride of the anti-suffragist, that the war-work of women made their enfranchisement a necessary reward for services rendered in trams, munition works, and elsewhere, she knew that their enfranchisement had its roots in something far deeper and older than these ephemeral activities. But she had a sense of humour and could afford to laugh, as one sometimes heard her laugh, at the manner chosen by the enemy to cover his retreat. Victory was at last won, and she had lived to see it; and I suppose there is no joy so completely satisfying as that which is felt by the reformer, who lives to see it proved that the cause which was once derided as a losing cause is the only kind of cause that ever wins. That joy was certainly Hertha Ayrton's on February 6, 1918.

I sat with her in Queen's Hall, when the National

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Union of Women's Suffrage Societies held their Victory Celebration, presided over by Mrs. Fawcett, who in the early days of the movement had written words of encouragement to the woman at my side on her first modest invention of a line-divider. And, of course, Mrs. Ayrton was also present at the less ceremonious if rather merrier celebration of the United Suffragists, held appropriately in Caxton Hall, whence in militant days so many of their members had gone out to risk arrest in Parliament Square. "Please wear decorations (prison or otherwise)," ran the United Suffragists' invitation card, at the left-hand corner of which stood the announcement—"Smoking, War Rations, Lightning Speeches and General Rejoicing." Mrs. Ayrton did not make one of the lightning speeches, but she keenly appreciated the humorous anecdotes that besprinkled the militant reminiscences of others who spoke that afternoon, among whom was Mr. Gerald Gould, one of whose epigrams is unforgettable. Speaking of the tendency to blame women for everything, he observed that a change had come over the attitude of those who used to sneer at the learned woman, but now reserved their censure for the wage-earning woman who was forced through low wages to undercut men. "In fact," he concluded dryly, "the blue-stocking has become a blackleg."

At yet another suffrage celebration, organized by the Women's International League, on whose platform women of various nationalities met and congratulated the British women on their victory, Mrs. Ayrton was again present and went on afterwards to a reception given to entertain some of the foreigners. She was particularly interested there in the Russian representative, Josephine Calina the writer, who had suffered as a young girl in a Tsarist prison. Russia had just passed through her Revolution, and Hertha Ayrton, hater of

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all tyrannies, was naturally enthusiastic over the downfall of Tsarism.

As soon as the war was over, Mrs. Ayrton was able to continue her scientific work with a sense of tension relieved. The Royal Society gave her an early opportunity of making public her paper embodying the scientific account of her invention, which had been communicated to the Society by Professor Mather, F.R.S., in a sealed packet, in September, 1917, and held over for the period of the war for fear of giving information to the enemy. She read this paper [1] on June 26, 1919, and showed experiments in which gas attacks were simulated by brown-paper smoke and directed against miniature trenches and dug-outs, then repelled in a few seconds by the use of a tiny model Ayrton fan.

These experiments demonstrated how vortex rings were formed in the air when the fan was brought down flat on parapet or ground, and then how the rings travelled forward and coalesced into one another and formed larger and more rapidly rolling rings—similar to the water vortices she had shown formerly by means of aluminium powder thrown into oscillating water. It was shown clearly that the user of the fan must stand with his back to the fresh air, and also that the fan, when lifted into space, produced no suck-back of the air; only when brought smartly into contact with ground or wall did it set in motion the necessary vortices of air. The inventor summed up the scientific expression of the phenomena in question in the concluding paragraph of her paper:

"Roughly speaking, one of these fans, in action, divides the space around it into regions, separated by a vertical plane passing

[1] "On a New Method of Driving off Poisonous Gases," by Mrs. Hertha Ayrton (*Proceedings of the Royal Society*, A, Vol. 96, 1919).

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through some line in the blade of the fan parallel to its tip. *From* the region behind the fan, air is sucked, in *irrotational* motion, in all directions, *towards* the fan; *into* the region in front, air is driven forth in *rotational* motion *away* from the fan. The fan cannot therefore be said to create a current in the ordinary sense of the word. What it does is to collect air from one wide region into a narrow space, and there to give it energy, both rotational and irrotational, by means of which it passes into another region, in which it moves through a longer, wider and higher space than that from which it was collected. The fan is therefore a factory for turning still or comparatively slowly moving air into powerful vortices, which, by coalescing and reinforcing one another, are able to move through an enormous area, and to drive before them, in an ascending forward-moving stream, the air or gas that previously occupied the space through which they travel."

This paper on the anti-gas fan was accepted by the Royal Society and published in October, 1919. It excited much interest, which was maintained by a demonstration given by Mrs. Ayrton in her laboratory to representatives of the Press, the two best notices of which appeared respectively in the *Illustrated London News*, accompanied by an admirable page of pictures drawn by Mr. W. B. Robinson, and in the *Manchester Guardian*. In the latter newspaper the interesting prediction was made that the invention would have "a lasting effect upon industry," probably proving "of great value when applied to the ventilation of cinema halls, of mines and of factories where noxious gases are developed."

The inventor gave one more lecture on the subject, at the beginning of 1920, at University College, London, to a meeting of the Science Teachers' Association, who asked her to be their President, a post that she declined.

"I spent all yesterday afternoon being photographed by the various agencies," she wrote to Mrs. Chaplin at Little Baddow—"a process I should always refuse, but which Barbie insists on my allowing.

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Vanity alone would keep me from it, for each one makes me look more like an old hag than the last!" Another tribute was paid to her invention when Lady Norman, C.B.E., Chairman of the Women's Work Sub-committee of the Imperial War Museum, wrote to ask her for the loan of one of her fans for the Anti-gas Section in the forthcoming exhibition of war-work at the Crystal Palace.

Her own interest in her fan, after the war, lay entirely in exploring its further possibilities. This had been in her mind during the war period, for even before she was asked to extend its operations to the ventilation of "pill-boxes," she had been paying some attention to the question of fire-brigade fans, for the purpose of enabling firemen or others to enter and escape from rooms choked with smoke. This idea, however, seems to have been pushed aside by other considerations, and was never taken up again; and a similar fate befell a proposition she had under review in 1917, for the use of her double mechanical fan in the ventilation of warships. On December 24, 1917, she wrote to Mr. Greenslade that Mr. Wordingham, President of the Institution of Electrical Engineers, and also Electrical Adviser to the Admiralty, had written to ask her if the fans could be used to ventilate warships—then very badly ventilated. "I told him to come and see for himself," she writes:

"I arranged the old broken 11 ft. trough as a room, with a cover, in which I put the tiny double fan (blades 2 in. by 1¾ in.). In the trough I arranged cigarette boxes and blocks, placed so that it was most difficult for the air disturbance to get inside them, to show how the smoke was dragged out. Mr. Wordingham came, and saw the trough cleared, after being completely filled with smoke, in about 35 seconds by the little double fan, which played up well. He seemed dumbfounded, and said the fans would work a revolution in the ventilation of warships, and he went off at once and saw the Director of Naval Construction."

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The Director, however, was just off to France, and nothing came of his colleague's enthusiasm; so one is left to conclude that, as far as the Ayrton fan was concerned, warships were left unventilated. But, after the war, fresh ideas about the fan crowded into the inventor's mind, as soon as the Royal Society paper was off her mind; and the chief of these she mentioned in an interview she gave to a representative of the *Pall Mall Gazette*:

"I have now perfected a mechanically driven fan capable of driving back large quantities of gas in any wind; and at the present moment, utilizing the same principle, I am working on a patent designed to carry coal-gas long distances, thereby saving appreciably in the cost of distribution."

She was experimenting up to the end of her life on this particular problem of the transmission of coal-gas, which, if perfected, would do away with the necessity for separate gas-works in every district; and she wrote on January 1, 1921, to Mrs. Zangwill, then spending the winter in Switzerland with her family:

"My work is going splendidly, and is quite enthralling; but I never seem to be able to get on fast enough with it. I have been looking up the way in which gases have hitherto been sent through tubes, and I find that the only people who have tried distributing it on a large scale are the X——'s. They are therefore the only people, with mains already laid, to whom I could apply to try my plan of sending it with fans. I rather fancy their own system broke down, as one never sees the Company mentioned; and if so, it broke down just because the distribution was so costly. I reckon the fans would save something like 95 per cent. of that cost. When I am ready I shall get Mr. X—— to come and see my small model, with the 2½ in. fan, turned very easily by hand, driving smoke through 96 feet of tube in less than half a minute."

To carry out these later experiments she had her laboratory fitted with pipes running round the floor; and, just before her last illness, she was having a similar length of glass tubing made, in order, as she put it, "to

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see what the gas really does inside the pipes." Always, however keen she felt on the ultimate purpose of any investigation she was making, she could no more resist going off on a fascinating side-issue and discovering what she might by the way, than she had been able to resist, in Girton days, the temptation to tackle insoluble mathematical problems, when she ought to have been working for her Tripos.

She did not lose sight altogether of the application of the fan principle to ventilation; for she wrote to Mrs. Zangwill in May, 1921, to describe one of her excursions in this direction:

"I paid a very interesting visit to the Sewage Outfall Works at Barking, and got the superintendent to come and see the fans I proposed should be used by the gangs of men who have to enter the sewers. He declared they were exactly what was wanted, and he should recommend their adoption, but that there are others over him who have to be consulted. . . . The fans I propose are a modification made after I had been to Barking and found out what was required. It is a small fan with a platform to beat it on, made also of canvas and cane. The two together weigh only just over a pound, and they are to hook on to a belt, one on each side, so that they can be taken off and used in a second, at the first indication of gas. Or they can be used as the man walks along the sewer, repelling both gases and odours before he advances."

This last was a development towards which she felt particularly attracted, on account of its bearing on the unsatisfactory conditions under which human beings have to perform necessary, but often very unpleasant and dangerous work; and if it had come to anything, it might have been applicable also to the ventilation of mines; but it seems, like much else, to have been laid aside with the intention of being resumed later. This was the fate also of her scheme for using her mechanical double fan to keep factories clear of noxious vapours, where these are engendered by the nature of the work

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done in them. Very unfortunately, the sudden death of a highly placed Government official, who was particularly struck by this idea and was bringing it to the notice of the Home Office, checked the project for the time being; and a fitting memorial to Hertha Ayrton would be the pursuance of her investigations in this industrial direction by some physicist equally interested in the beneficent applications of science to everyday life.

Another important piece of research, which occupied her mind during these last years, is referred to in a letter to her daughter Barbara (June 23, 1920). The mention occurs in the course of an account of the Royal Society's Conversazione, which was held the night before, and which, she told Barbie, she had "some qualms about attending, because I thought it quite possible the scientific world might boycott me!" But, she continues jubilantly:

"Not a bit of it! Sir J. Thomson held my hand a long time, and he and Lady Thomson were most cordial. . . . Most amusing of all, Sir James Crichton-Browne shouted half-way across the big reception hall: 'Well, have they given way about the fans? You've made a splendid fight!' by which time we had shaken hands, and he went on: 'It's just like them!' I got promises of papers read during the war, for University Professors in Vienna, and should have got more, but that I kept forgetting to ask amid all the turmoil and shaking hands and talking. . . . Mrs. Holman Hunt and Gladys and dozens of people asked after you, and Lady Dugald Clerk (do you remember going with me to her flat to beg for money for the W.S.P.U. ?) was most affectionate in her inquiries. There was a sort of concert sent up from Chelmsford by wireless. Very wonderful when you think how it was transmitted, but as a concert—well!"

The passage in this letter, which contains the interesting scientific allusion, runs as follows:

"Sir Charles Parsons had an exhibit of his apparatus, showing that you can pierce metal by the rush of water into a vacuum created by suddenly stopping water which has a great pace on.

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It would take too long to explain, but it is simply a special case of my ripple vortices and *proves* my theory of them, propounded in *1904* and refused by the R.S., and proved by me in another way in my 1915 paper. You remember I told you that I thought this thing of his was mine in another form, so I was tremendously interested to see it last night. When I *had* seen it, I explained to its exponent about my two papers, and he agreed that Sir C. P.'s thing was really the same. He was most amiable and gave me one of the pierced discs. I shall now certainly ask Sir Charles Parsons to communicate my next Royal Society paper, which is all connected with the same thing, but rather a sensational development of it. My stars! What a lot of work I have ahead of me, and an evening spent like last night makes me wild to get on to it! This new paper is three-quarters done, but I put it aside for fans."

The reference here is undoubtedly to a paper on "Primary and Residual Vortices in Oscillating Fluids —their Connection with Skin Friction," which was found among Mrs. Ayrton's documents after her death. It is probably the paper of which she wrote to her cousin in Vienna, Miss Levetus, on February 6, 1915, saying: "I am going on with my work on the movements of water, and have just finished one paper and begun another." The finished paper referred to here is the one on "Local Differences of Pressure near an Obstacle in Oscillating Water," which she read to the Royal Society in May 1915, and which gave her the inspiration for the anti-gas fan. But the second paper mentioned (naturally dropped when her war invention claimed her undivided attention) must have been the one alluded to in the above letter to her daughter, the paper which she left in manuscript at her death. It is possible that some of the experiments described in it were the outcome of the work she did when re-writing her rejected paper of 1911, which she told Barbie in another letter (September 3, 1917) she meant to finish and submit again to the Royal Society. This project was never carried into effect, nor was the second paper, the one found after

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her death, ever submitted.[1] Very probably it was a sense of all her unfinished work in connection with water-movement that weighed on her mind after the war, and made her give the impression to those around her that she was working against time, with a constant fear in her mind that she would never finish all she wanted to do. Mr. Greenslade has told the present writer that she often spoke to him, when he was helping her with her later experiments, of the time at her disposal being so short, and of the amount of material she still had to publish and give to the world. Her letters convey the same desire to push on at all costs with her work, though her health, much impaired by overwork and worry during the war, handicapped her perpetually; and she was frequently compelled to pause just when she was most interested, and to rest against her will.

"The difficulty was always to keep her from knocking herself up," Mr. Greenslade has said more than once; and I am indebted to him for an account of her method of working. During the fan period, she worked from ten a.m. until lunch-time; after lunch she would take a short rest while Mr. Greenslade prepared the laboratory for fresh experiments; she would then work on till seven o'clock, with fifteen minutes' rest for tea, and would often spend the evening in looking over her notes, thinking over the results of the day and reasoning them out, seeing possible faults and devising fresh developments. No trouble was too great for her. Her extreme patience in making experiments, in simplifying apparatus until there could be no doubt of results, her acute observation during the experiments and speculations as to the causes of everything she observed and

[1] This MS. paper is to be presented to the Royal Society by Professor Mather, F.R.S., and will probably be read this session (Spring, 1926).

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saw happening—all this was characteristic of the way she worked in the laboratory. Her skill in making her own apparatus has already been mentioned; over her fan work this became extraordinary, especially in the drilling of minute holes. After the war, her assistant noticed especially a tiny contrivance she invented for the purpose of observing the speed with which coal-gas could be driven through tubes; it consisted of a morsel of feather on a single thread of silk, anchored to a hat-pin. Yet, for all her care in devising and making these miniature contrivances, she had no further interest in them the moment their work was done. "Break it up," she would say ruthlessly; "the materials will come in useful at some future time." She never allowed the means to obscure the end; and that cannot be said of everybody who experiments, in physics or in life. "And with it all she was intensely human," concludes Mr. Greenslade, summing up his impressions of the woman whom he assisted so often in her work, and whom he knew as an enthusiast who never spared herself but never overtaxed anybody else.

Fortunately, in spite of her failing health and the strain she put upon it, her natural vitality did assert itself and enable her to extract much pleasure, in her last years, from the world outside her laboratory. The Girton Jubilee celebrations in July, 1919, gave her a pleasant opportunity of returning to a scene of former happiness, and of meeting again many old college friends. In one of her rare newspaper articles, which appeared about this time in the *Daily Sketch*, she wrote:

"When I went up to college in 1876, 'Woodhead, Cook and Lumsden, the Girton pioneers'—in the words of a college song—seemed already to belong to the dim and distant past . . . and the fact that Miss Rachel Cook had 'done a better paper on Aristotle than any of the men of her year' was only a glorious memory. . . .

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Although we were not pioneers, we were near enough to pioneer times to feel ourselves still part of a great experiment."

She had never lost touch with the college, and it must have given her great pleasure, returning there after many years, to find one of her old friends and juniors (Miss Kathleen Jex-Blake) Mistress of Girton, and to meet others with whom she had collaborated over founding the Fire Brigade, running the Musical and Debating Societies, and other college activities. She was described in the Jubilee number of the *Girton Review* as one of those " who by their greatness make us proud of being fellow-Girtonians " ; and the obituary notice of her that appeared in the *Review* (Michaelmas Term, 1923) contained a reference to her visit at the time of the Jubilee, in which it was mentioned that " her youthful appearance and simple friendliness made her seem like a contemporary among much younger people than herself," and so it " was something of a shock " to realize that she had known George Eliot and other friends of Madame Bodichon. On the Sunday evening of the Jubilee, July 17, 1919, Mrs. Ayrton gave an interesting account of her fan invention, in the Stanley Library of the college, which was filled to overflowing with past and present students. It is gratifying to feel that Hertha Ayrton experienced this genuine appreciation from her old college before she died, and to know further that her memory will be perpetuated there, not only in the Hertha Ayrton Science Fellowship founded by Mrs. Hancock, but also in the gift of five of Madame Bodichon's pictures, originally given to Hertha by the painter herself, and presented by Mrs. Ayrton Gould to Girton College after her mother's death.

Mrs. Ayrton's name became associated towards the end of her life with two new organizations, each of which

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made its special appeal to her. The first of these was the International Federation of University Women, founded in 1919. As a member of the Committee of International Relations, created for the purpose within the British Federation of University Women (of which she was a vice-president), Mrs. Ayrton was closely associated with the formation of the international organization, and very much interested in it. At the first meeting of the Committee of International Relations, held at Bedford College on April 22, 1919, there was a slight tendency, not perhaps unnatural at that date, to regard an International Federation as merely a Federation of the Allied nations, although Professor Caroline Spurgeon (the prime mover in its formation, with Dr. Cullis) was herself a real internationalist. Mrs. Ayrton made a vigorous speech at this preliminary meeting, pointing out the desirability of so framing the constitution of the new organization as not to exclude the university women of any nation; and she embodied her views in a resolution, which was seconded by Professor Spurgeon and passed by the Committee, recommending the Executive of the British Federation of University Women to invite the American Association of Collegiate Alumnæ to co-operate with the British Federation "in the formation of an International Federation of University Women." The result was the foundation, on July 11, 1919, of the International Federation at a meeting of representative university women of Great Britain, Canada and the United States, held at the London School of Medicine for Women.[1]

[1] The object of the International Federation of University Women is "to promote friendship and understanding between the university women of the nations of the world, and thereby to further their interests and develop between their countries sympathy and mutual helpfulness." Three Conferences have been held by the Federation

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Mrs. Ayrton continued to serve on the Committee of International Relations until the press of scientific work forced her to retire from it. I had an interesting confirmation of the kind of influence she exercised there from an American woman graduate who was a Quaker, and whom I met in Berlin in August, 1920; she told me how much Mrs. Ayrton had impressed her, in a speech she made at a meeting, with her keen internationalism. This American Friend described her as some one with extraordinarily bright eyes and vivid personality, so that it was easy to identify her even before my informant went on to say how delighted she had been to discover that the speaker was the eminent physicist, whose invention for the saving of life was so exceptional among war inventions.

The formation, in June, 1920, of the National Union of Scientific Workers, in which Professor Soddy was largely instrumental, also appealed greatly to Mrs. Ayrton, who became one of its original members. It interested her on the democratic as well as the scientific side; for it was the first organization, with a trade union constitution, composed of scientific workers, and its membership was free from barriers of sex or class.

—in London in 1920, in Paris in 1922, and in Christiania in 1924; and at the moment of writing (1925) twenty-one countries are represented in its membership.

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CHAPTER XX

THE END OF THE JOURNEY (1920–23)

As the life journey of Hertha Ayrton draws to its end, one cannot help being struck by the characteristic manner in which her temperament reacted to the events and tendencies of the post-war period. It was no doubt thoroughly consistent with her whole previous career that she should find herself in furious revolt against the policy of the Great Powers regarding the reconstruction of Europe. She had already, during the war, hotly condemned many of the repressive measures of our own Government; and when Israel Zangwill sent her an article of his, written in defence of the late Mr. E. D. Morel, who had just been sentenced to imprisonment for a technical infringement of the Defence of the Realm Act, she wrote to tell her son-in-law that she had read it "with a mixture of pleasure and indignation—pleasure at what you said and the way you said it, and indignation at the treatment accorded in 'free and democratic England' to such a man." Similarly, when, after the war, Mr. Zangwill sent her a copy of his play, *The Cockpit*, she wrote to thank him as follows:

"I have read *The Cockpit* with intense interest, and I put it down with profound sadness as you intended one should. Poor Queen! Poor people! You have given a wonderful picture of the way in which both people and monarch are at the mercy of a tribe of scheming self-seekers, and the horror of it is that one sees no way out—neither do you. The herd instinct played upon by astute

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diplomatists (including financiers, and specially financiers) will carry a whole people just wherever the astute ones want them to go. They have only to call it patriotism or self-sacrifice, or any other high-sounding name, and the vilest passions are let loose under the camouflage."

Directly the war was over she wrote to Madame Curie for news of herself and her children, and received a reply on December 15, 1918, containing the following passages:

"Comme vous, je suis heureuse que la guerre est terminée. J'espère aussi que la paix sera bonne et qu'elle assurera aux peuples plus de bonheur qu'ils n'en ont eu jusqu'à présent. Vous devez être très contente de voir que la question des droits des femmes a fait un progrès sérieux et que bientôt elles seront citoyennes dans tous les pays. . . . C'est un grand moment pour la Pologne; et je suis très contente d'avoir vécu assez longtemps pour avoir vu la Pologne libre et indépendante."

To this communication Mrs. Ayrton replied, some weeks later, in the vein of mingled sadness and indignation that marked her attitude towards public events at this time. "The Peace Congress"—she wrote—

"seems to be dragging on very slowly, and the League of Nations—a real League, not a Clique—appears to be as far off as ever. The withholding of food from the starving nations, and the failure to raise the blockade, make one despair lest the horrible passions of war may never be replaced by pity, kindness and brotherhood. I wonder what you think of it all, you who are in the very midst of the discussions. It seems to me that greed and revenge are the master passions in men's minds, and that the new and better world we were promised has resolved itself into a chaos of snatching and grabbing."

It was quite natural that her intolerance of injustice and her sympathy with suffering of all kinds, especially the suffering of children, should have made her strongly critical of those politicians whom she held responsible for the continued misery of devastated Europe. On my own return from abroad, in August, 1920, I spent a few days with her at Little Baddow, where

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she was resting for a week or two; and she was deeply moved by what I told her of the German victims of the blockade, especially the young children and the students. She was kept in touch with the relief work in Austria through her cousin, Miss Levetus, who was co-operating with other residents of Vienna in assisting the unfortunate English wives and children of Austrians, deported there from England. "The help that Hertha sent me, her sympathy and practical advice—it was at her suggestion that I got into touch with the Friends' relief work in Vienna—often urged me to go on with my mission, which lasted quite three years, when my own physical strength was almost at breaking-point," Miss Levetus told me, when recalling her experiences in Vienna of the dreadful years of privation, 1918–21. Among the Austrian scientists that Mrs. Ayrton tried to help at that period was Dr. Karl Horovitz (holder of a Rockefeller scholarship at Toronto University); she had a great admiration and regard for his work, and corresponded with him and sent him scientific pamphlets he could not otherwise have procured at that time.

She, in common with other thinking English people, was equally concerned about events at home. Writing her New Year's wishes to Mrs. Zangwill in January, 1921, she says: "I suppose there never was an unhappier year than this last has been to so large a number of people—not even during the so-called war years, when the war was more overt but not more real." She refers in the same letter to the state of Ireland and the coercive Irish policy of the British Government, adding:

"English people are at last beginning to realize it and are waking up to a sense of horror and shame. The Labour Report and the campaign in the country which they are initiating will stimulate this, until at last, I hope, the country will be fairly roused and will insist upon the withdrawal at least of the Black-and-Tans and

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the Auxiliaries. God knows how long it will take to reach even this stage, for the spirit of Prussianism seems fairly to have got into our bones since the 'War to end War.' Meanwhile the unemployed are increasing by leaps and bounds here."

There is no doubt that the evidence she saw on all sides of the evil effects of war, both on individuals and on Governments, did very seriously wound her sensitive nature, already wearied by her own contest with officialism. We see signs of this fatigue of the spirit, from which no man or woman, however great, is ever great enough to be wholly free, in the letter she wrote to Israel Zangwill on his book *The Voice of Judaism*, which must be quoted here if this picture of her is to be a complete one:

"It is a great book in every way—great in idea, great in execution. . . . One idea has struck me in reading it which never occurred to me before. You think one of the great gifts of Judaism to the world is the idea of a single God. Well, considering the profound and horrible muddle the world is in and the tale of suffering of all kinds that the ages have told, I cannot see that it matters very much whether it is the work of one or many gods; and if they were many you might have the consolation of knowing that none was omnipotent and so they were not responsible, since whatever one did another could undo. The longer I live, the more convinced an agnostic I become, the more certain it seems that we know and can know nothing about the beginnings of things or their cause. The great mystery seems to me to be how or why there ever was anything at all.

"The book is so compact of food for thought that I find it very difficult to put what I think about it into words. The Proem and the Epilogue are both most beautiful, and the 'Legend of the Conquering Jew' expresses what I have long wanted to see done. . . . Your disdain of science earlier in the book touched me up, but that is an old quarrel between us, and a small detail. On the whole I do thank you with all my heart, not only for having given me the book, but for having written it."

Religion is so personal, and at the same time so elusive a part of anyone's being, that it is doubtful whether the biographer has either the right or the ability to pry

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into its intimacies or to attempt to confine it to a formula. But Hertha Ayrton's sincerity of thought and honesty of vision were so striking during her lifetime that it becomes possible, after her death, to approach the subject without a sense of intrusion. Her agnosticism always seemed to me to proceed as much from her suspicion of the easy beliefs and mechanical observances of unreasoning religious persons as from her scientific instinct to prove all things in order to hold fast that which was good. It certainly was not based on any worship of materialism as such, or on any dogmatic assertion that the unseen was not capable of proof. Rank materialism could not exist in one who recognized as clearly as she did the place of imagination in scientific research, and who never hesitated to place principle far above personal gain. She was certainly not what is called a religious woman, for she worshipped no God conventionally, and entered no Church. But her whole private life, leaving aside her public career which can be allowed to speak for itself, was an unconscious demonstration of a practical religion that many who call themselves religious might profitably imitate.

Her goodness to any relaive or friend who seemed to want her help scarcely needs emphasizing again here; her response was always immediate and practical, as on the occasion when she left everything to go off and nurse Cécile Hartog and sit up all night with her, because a telegram came to say that her cousin had rheumatic fever and a nurse could not be found at once for her. But apart from her generous readiness to serve those she knew and cared for personally. she did innumerable acts of kindness which were probably unknown to all who were outside the inner circle of her intimates. Her friend Ottilie Hancock used to say to her: "It

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is no use trying to interest you in anyone who is not poor or suffering in some way!" and the same thought probably predominated in Mrs. Ayrton Chaplin's mind when she said of Hertha that "she always had a strong feeling about the sufferings and miseries of the world, and would have had every one enjoy the advantages she enjoyed herself." This sense of the inequalities of fortune made her respond lavishly, and with quite an unscientific disregard of the value of investigation, to every demand made upon her generosity; and the effect of this prodigality upon her purse was sometimes so marked that one used to find her indulging, as only extravagantly generous people ever do, in absurd little economies, such as the substitution of margarine for butter at her own table—she never economized at the expense of her household—or the neglect to replenish her wardrobe until it reached a simplicity that provoked the stern intervention of her daughter. At the same time, she generally endeavoured to make her help constructive, finding employment wherever possible for her many beggars.

Once, when a provincial Mayor postponed giving assistance to a starving family until a report should have been made on their case, she exclaimed impetuously: "But they'll all be dead by that time!" and she proceeded at once to meet their immediate needs, and also sent away a tuberculous child to the country and saved its life. On another occasion, the chance discovery of a destitute family in a bare room, whence everything had been taken to be sold for food, sent her home raging, to tear up her own bedroom carpet for their use, after which she refused to substitute anything for her own use but an old mat from the lumber room—"because, you see," she explained to an expostulating maid, "it would not otherwise be any sacrifice on my

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part." One of the most courageous things she ever did, and she did many, was to save the life of a woman in her service who set herself in a blaze with petrol. Hearing her screams, Mrs. Ayrton, who was working in her laboratory, went at once to her aid, and extinguished the flames with her own hands, then rendered first-aid to her and took her to the hospital; after which she probably saved the poor thing's reason as well as her life, by letting her know that her invalid husband and children were being cared for in her absence.

There was not a person who ever worked for her who did not respect and admire her, whether it was the little scatterbrained waif from the East End, who, because she was believed in by her mistress, rose from the scullery to be parlourmaid, and only left after many years when family illness summoned her to Australia; or the incompetent, post-war, ex-munition worker, who with some condescension undertook to be housemaid at high wages, and then, from daily contact with Mrs. Ayrton and the atmosphere she shed round her of honesty in work as in remuneration, came of her own accord one day to her mistress, and offered to take lower wages until she had learnt her job properly. This girl must have encountered that strain of something unusual in her employer that somebody else, who also experienced Hertha's kindness, tried to explain to the present writer by saying: "You knew that with all her mental brilliance she was the personification of modesty and simplicity; and yet one felt behind all that a tremendous force that would lift one up to the skies."

Of course she was sometimes taken in, perhaps often. But, as she once said to a friend who carried out some of her charitable missions and had just brought her a flagrant instance of fraud and ingratitude: "We cannot judge; we don't know what made them like

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that;" and she preferred always to take the risk of being cheated rather than run the greater risk of distrusting some one who really deserved her help. It was said in her household that no one was ever turned from her door; she would frequently bring home to dinner some starving person she had met in the street, and once, when a ragged fellow asked her for socks—of which she kept a supply in the house—she replied in her direct manner, at once so humanly reasonable and so worldly foolish: "But socks will be of no use to you unless you have new boots too!" and sent out for a pair to be bought for him.

Probably, not one in a hundred of those who knew Hertha Ayrton the scientist knew what Hertha Ayrton the woman was like. "You think she was great in her public life," said one of her oldest servants to me after her death; "but she was far, far greater in her private life." To be a heroine to your maid is at least as rare and as difficult of achievement as to be a hero to your valet. Hertha Ayrton, with her rejection of religious dogma because it seemed to her incapable of scientific proof, took all humanity on trust without asking for any proof at all, and flung reason and logic to the four winds when a graceless beggar came knocking at her door, or a sufferer of any kind and any race happened to wander across her path.

Her temperament, therefore, would have inevitably drawn her towards the people's party as soon as the enfranchisement of women made her free to attach herself to a political party. She would doubtless have been attracted in this direction anyhow, through the close association of Gerald Gould with the editorship of the Labour newspaper, the *Daily Herald*, and also by Barbara's active support of the Labour Party after a period of international propaganda as honorary

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secretary of the Women's International League. But the democratic tendencies of a lifetime were quite enough in themselves to secure Hertha's adherence to the youngest and most progressive of the three political parties; for in its foreign and its home policy alike, the Labour Party appealed to her pacifism, her internationalism and her perpetual pity for the sufferings of the common people. She could never follow any party blindly, however, and there was always much discrimination in her support of Socialism and Socialists. Before organized Labour really became a power in politics, this passage occurred in one of her early letters to Barbara (March 25, 1910):

"Edie ends up her letter—'I must go round and see how badly they are laying the tiles.' She is becoming a very chastened character under the influence of the British workman. I wonder if he will really improve under a Socialistic regime, because there is enormous room for improvement. Of course, the fact is that it is not only the workmen but the masters who shirk, only we come across the workmen and women more. I must say I do think that servants are, on the whole, a very conscientious lot compared with other workpeople."

She joined the Labour Party and believed in it as much as in any political party. How much that meant may be conjectured, perhaps, from a letter she wrote to Mrs. Ayrton Chaplin (January 1, 1920) in which she says:

"I have been deeply interested in all the Labour victories at the polls lately. Labour appears to be coming into its own much sooner than I ever expected it would. I only hope it will prove more sincere and more generous than the other classes, who have had power, have been. Even generosity is not so important, however, as sincerity. If only they will be honest and not try to trick the public at every turn, that in itself will be a revolution; but power seems to have such a disintegrating moral effect that it may yet be a long time before we get an honest Government. It cannot, however, help being better than the present one. I am appalled at the record we are building up for ourselves, and I feel

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sick with shame and horror at what has gone on in India, Egypt and Ireland."

It was consistent with her social philosophy that in the same letter she said, speaking of a small cottage she owned at Little Baddow, near her former house:

"We have not made up our minds what to do about it, and would like to know what you think. I wanted formerly to keep it as a week-end cottage, but I should not feel justified in doing so now that so many people have no house at all."

Equally consistent is the circumstance that almost the last question on which she made a public pronouncement was the proposal to charge a fee for admission to the British Museum, against which she expressed herself energetically, in an interview she gave to a representative of one of the papers.

Although it is true that public events had saddened her much during the latter part of her life, the impression should not be conveyed that she ever became an embittered woman. Hers was much too big and humorous and lively a nature for that; and one of the sources from which she derived real happiness, and so recovered much of her natural gaiety during these years, was the company of her grandchildren. Her love of children had continued unabated all through her life from the time when she mothered her little sister and brothers, at home in Portsea. A Kensington friend, whose little boy in early days shared lessons with Barbara for a time, has written to me of Mrs. Ayrton's "horror of the beating of small children," which once led her to "follow a nursemaid home from the Park whom she had caught ill-treating her small charge in this way." The same correspondent speaks, too, of her "tenderness and motherliness, that were far from being reserved for her own belongings."

Still, it was of course her own belongings that brought

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her the keenest joy she ever felt in the company of children, first during the childhood of her daughter and stepdaughter, and afterwards in that of their children. Mr. and Mrs. Zangwill had three children; Ayrton, Peggy and Oliver. "Why Oliver?" wrote his grandmother on hearing of his birth in 1913; "is it after the great Cromwell, or only because you like it?" And in 1921, Barbara and Gerald Gould's son, Michael, came to bring her the greatest delight of all. In her busiest moments, when she was least able to consider herself a "private person," Mrs. Ayrton always seemed able to spare a corner of her mind for her grandchildren. She wrote once to Mrs. Zangwill about Ayrton, who at a very early age showed a remarkable talent for mechanics:

"I agree with you about Ayrton. He does not want to be alone, but to be *let alone* to follow his own thoughts, which is different. Every year, he will be easier to manage—it is only that he cannot be treated in the usual way, and that is always difficult because there is nothing but experiment left to find out what *is* the right way."

Her views on the upbringing of children, which correspond to her views on personal relationships generally, are discernible in the gossip about her grandchildren that is scattered through her letters. Thus, she writes again to Edith Zangwill:

"I am much amused at your firm determination to let people think Ayrton spoilt if they will, and not bother, because I came to exactly the same determination about Barbie, and in the same definite way. It is bad enough to be governed by what other people think in the ordinary everyday things of life; but to spoil one's children's lives because people will think we spoil *them*, is going too far in complaisance."

And in another letter:

"You were perfectly right to tell Charles to hit Ayrton back if he struck him again. That is a sort of natural justice which every child understands, and the very fact of your having said it

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would make Ayrton restrain his exuberance in the future; it would have the effect of a natural consequence, and nothing is more effectual than a natural unpleasant result of one's own misdoing."

The house at Norfolk Square was always open to the younger generation, and it must have been a delightful playing-ground, though it would be difficult to say whether these occasional visits to London were the more enjoyed by the little guests or by their hostess. "Peggy has the knack of getting on with her fellow-creatures," wrote Mrs. Ayrton during one of these visits; "she has 'a way with her,' which is perhaps the greatest gift Nature can bestow." It certainly must have been a very successful "way" where her grandmother was concerned, if we may judge by the following extract from another communication:

"We played a game to-day, in which Peggy took the parts of Bobby, the Mummy, the Daddy, the Nanny and the Baby in succession, and when she was one of these I had to be any other that occasion called for! It was a little bewildering: sometimes I was the Mummy when I ought to have been the Nanny, and so on. But I managed to escape too many rebukes."

But the grandchild who absorbed her affectionate interest more than any other was Barbie's child Michael, who was born in February, 1921. On him she lavished unlimited tenderness, and the greater portion of her leisure, all through the last two years of her life. Every day he came round to Norfolk Square in his perambulator, and any visitor who dropped in about tea-time would find them together in the drawing-room, she singing her old French songs, and sometimes old English folk nursery rhymes, as she used to sing to her own little daughter. It was very pretty to see them together and to hear the baby voice echoing the refrain. Once, when the visitor happened to be the doctor, Michael greeted him gravely with: "An apple a day keeps the doctor

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away"—a hint that fortunately carried no offence with it.

"I have had a really beautiful holiday, thanks to you and Israel, and it was specially delightful to have all four grandchildren together," she wrote, after returning from a summer visit to Far End, in 1922, where Michael was staying with his cousins. Indeed, very few of her private letters fail at this time to contain some allusion to the adored grandson; and almost the last picture left in one's mind of Hertha Ayrton is of them both, in the garden of a little house at Wendover at the foot of the Chilterns, where she spent the early summer months of 1923, Barbara coming and going with her husband as their work permitted them, but Michael always there, filling her life with amusement and pleasure. She may be said to have been perfectly content for those few weeks in his company; and that is a blessed memory to retain of her last summer on earth.

"I am extremely well and enjoying the rest and quiet," she wrote to Barbie from this happy retreat on June 24, 1923; "and your boy is at the moment sleeping the sleep of the just in his car on the lawn, looking like a rosy little cherub." Madame Curie, in answer to an equally cheery letter, written also from Wendover, and the last she received from her English friend, wrote sympathetically: "J'ai plaisir à vous savoir dans votre campagne avec votre petit-fils, et j'imagine combien vous devez jouir de la compagnie de ce petit personnage." The little personage certainly helped to heal the wounds of a nature that had never learnt to meet unmoved the pain of the world, or to suffer gladly the fools, and tyrants, who seemed to her responsible for the pain. Little Michael Gould brought to life again the irresponsible child in Hertha that sur-

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vives in all charming people, and had certainly never died in her since she played as a gay little tomboy with flying hair, in her home at Portsea. When she returned from Wendover, that summer, it was said by all who knew her that she had never seemed in better spirits.

Her physical health, however, had not materially improved; and she had scarcely arrived at Far End, where she went on a visit after leaving Wendover, before she fell ill. She recovered sufficiently, after a few days in bed, to fulfil her promise to go on to the Sussex home of her old friend, Mrs. Rose, which was within an easy motor drive. Here she intended to complete her summer holiday; but her illness took a sudden and serious turn and proved to be virulent blood-poisoning, caused, it was conjectured, by the bite of a gnat, and accelerated, as some think, by the sensitizing effects of the smoke absorbed into her constitution through the continuous experiments she made in the last years of her life.

Her many friends, scattered in various places on their summer holiday, were shocked to read in their newspapers, one morning, that she had passed away on August 26, 1923, at the age of sixty-nine, leaving uncompleted much that she meant to do, but having accomplished very much more than most of us are content even to begin.

"She was greater in her private than in her public life." Those who knew her in both capacities would not dream of drawing a distinction between the two. In their eyes, whether as woman or as scientist, as personal friend or social rebel, she stood always for the same high mental and moral standards; for the same attractive human qualities and the human defects of those qualities; for the same single-mindedness and sincerity

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that made her a thorn in the flesh of the slacker or the prevaricator, but a friend and a colleague absolutely to be depended upon; and for the same uncompromising simplicity that her detractors might mistake for some limitation in her mental and spiritual equipment, but that others knew to spring from a clarity of vision and a purity of mind that no trace of worldliness or self-interest ever dimmed. Hers was a personality that provoked hostility—if the varied opposition she encountered in her progress through life could ever be given so sinister a name—not by reason of her defects, but rather by reason of her qualities.

All over the civilized world, obituary notices, most of them full of admiration and praise, and only one, I believe, really unjustly critical, appeared in newspapers and scientific journals; and interested strangers dwelt on her career, as such onlookers do, for a passing hour. But her lasting monument will not be found in the appreciation of intelligent strangers, or even in the affectionate memory of those who knew and loved her, but rather where she would have wished it to be found—in the laboratories where science is brought to the aid of humanity, where others will develop the discoveries that she made, and carry on the investigations that she began—perhaps without knowing to whom they owe that beginning, so remorseless is the impersonality of science—and where the contribution that she made to the vast sum of human achievement will inevitably bear its fruit, even when the sower of the seed has passed into forgetfulness.

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contact were Madame de Bodichon, Prof. Darmesteter, Prof. J. R. Green and George Eliot. The famous novelist is believed to have drawn a picture of Hertha Marks in the character of Mirah in "Daniel Deronda."

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